

# PLASTICS

A Periodical Devoted to the Manufacture and Use of Composition Products

BUREAU OF STANDARDS

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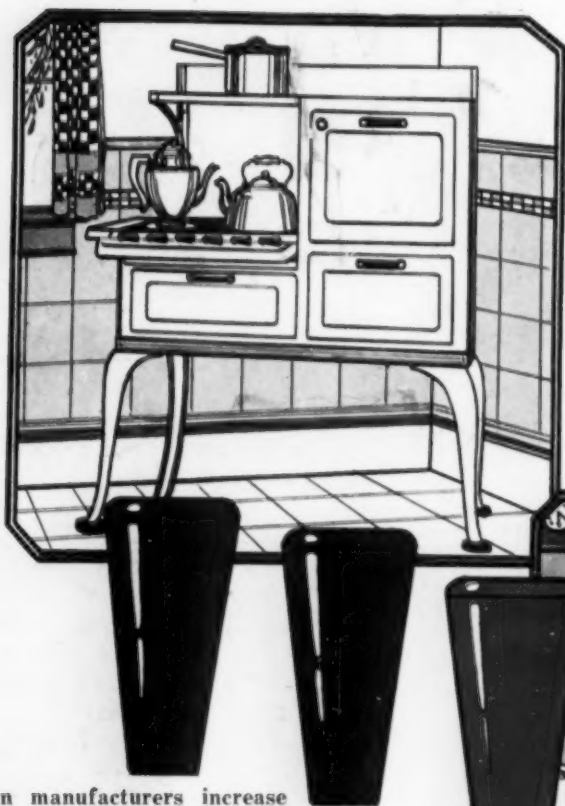
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*More*

# COLOR

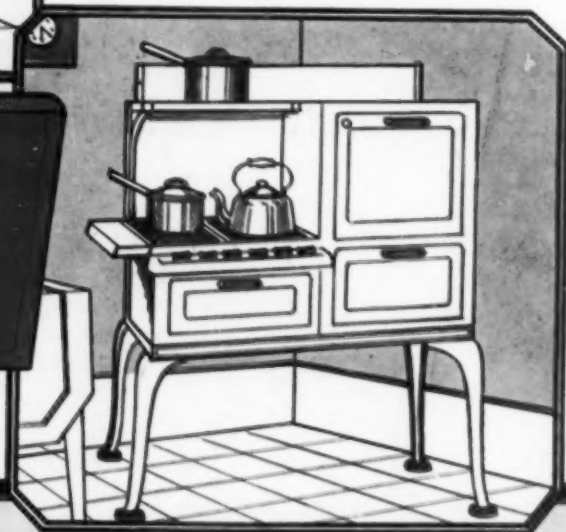
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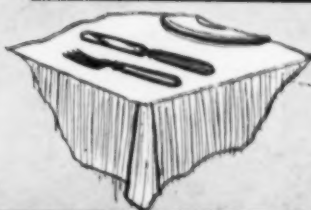


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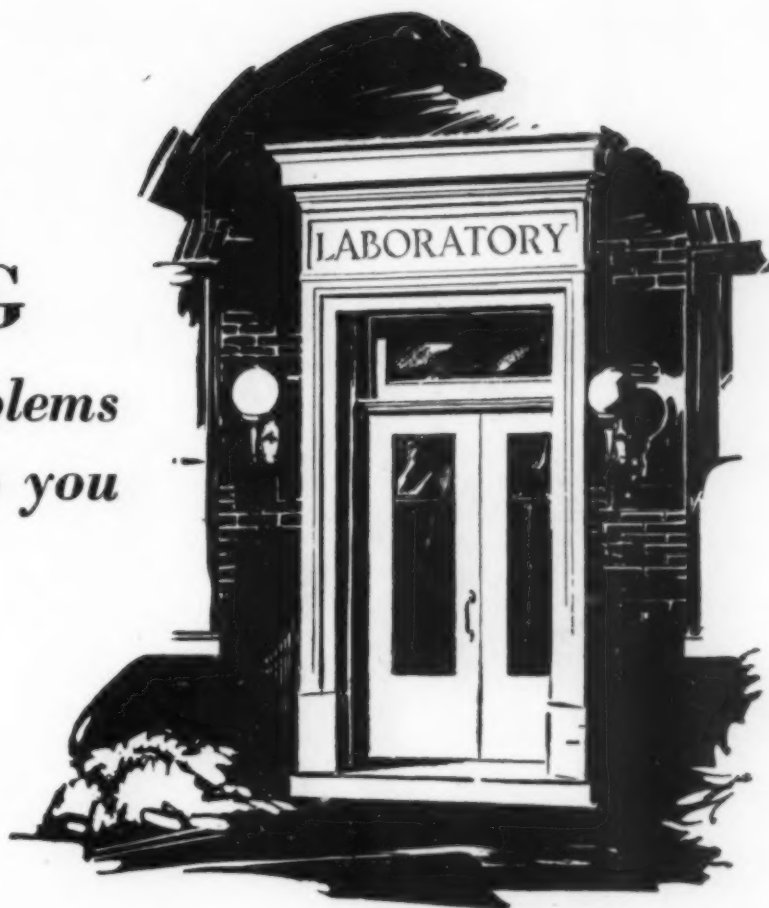
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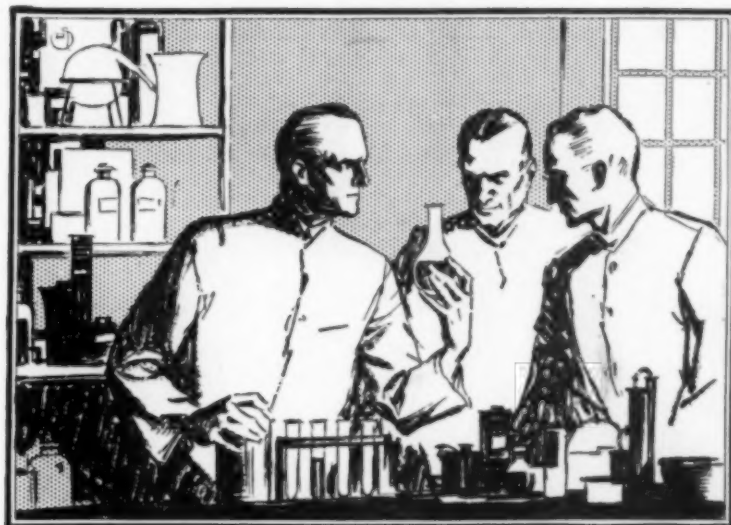
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Who is there in any business or industrial field that is wholly impartial? Only the publisher and editors of the organ in any such field, and the reason for this must surely be apparent even to the most avid controversialist. One branch of an industry can fail and its paper will still survive, but if business as a whole suffers a reaction, then the paper is apt to be in a different financial situation. Consequently impartiality is the life blood of the Publishers' bank account.

Well, we may risk your wrath, individually or collectively, any month now! What with the slump, attributed to the election scarecrow, call money up  $3\frac{1}{2}$  over a year ago, and the impossible situation among some of our so-called prosperous concerns, our pen is restless to begin its "desecrations"! We hope, nevertheless, to be able to clarify the situation in the plastic field and to build up for ourselves a more hardy reputation than has been heretofore enjoyed.

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Offices: 114 E. 32nd St., New York.

Telephones: Caledonia 5524-5525

Plastics Publications, Inc., Publisher

E. D. Sheriffs, Chicago Representative

80 E. Jackson Blvd.

Subscription Price—U. S. \$3.00, Foreign \$4.00 Per Year

Issued Monthly—35 cents a copy

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## No Plastics Without Solvents and Softeners

A concise description of the modern cellulose  
ester solvents, plasticizers and modifiers that  
are essential in lending to these esters the  
qualities of suppleness, elasticity and strength

By Dr. August Noll, Tilsit, Germany.

MODERN chemical industry has given to the field of plastics and lacquers quite an imposing array of special solvents and plasticizers that are now manufactured on a commercial scale. Most of these have particular properties that fit them for a certain use, and in my enumeration I will point out the salient characteristics of each of the solvents or plasticizers.

As to whether the product is a solvent or a plasticizer, an indication is given directly after its name, although many of the products are in reality both.

**Acetic acid esters (Solvents).** As the esters of the lower aliphatic acids are quite similar they are here grouped together for convenience. They are characterized by very rapid volatility and low boiling points, so that they are often used in celluloid cements and the like. Their boiling points are:

Methyl formate	32°C.
Ethyl formate	54°C.
Methyl acetate	57°C.
Ethyl acetate	77°C.

As the chemically pure esters in most cases are quite expen-

*Dr. August Noll, of Tilsit, Germany, has compiled a most interesting list of the modern cellulose ester solvents and plasticizers, giving both their trade names, technical names, formulae, and properties.*

*The present articles are based on three German articles that have appeared in our contemporaries, the "Chemiker Zeitung", 1927, No. 57, pp. 546-8 and No. 59, pp. 566-567; and "Farben Zeitung", 1927, pp. 1553-155. In order to, make future reference by our readers easier, we have re-arranged the substances in alphabetic form and have condensed the same as far as practicable.*

*Many of the products mentioned are useful both in the manufacture of cellulose ester lacquers as well as plastic masses.*

sive, they are usually found in the trade and the form of cheaper mixtures, being known (In Europe) as "Solvent E 13". This consists essentially of a mixture of methyl and ethyl acetates and forms a neutral

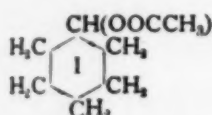
pleasantly smelling liquid, soluble in 4 parts of water and having the following characteristics: B. P. 65-73°C; Flash point -10°C.; sp. gr. at 15°C. 0.8937. While an excellent solvent, it evaporates so fast that the films are cloudy, so that it is necessary when blushing of the films is to be avoided to add some high-boiling solvent.

**Adronal acetate (Solvent).** Adronol acetate has practically superseded amyl acetate. A comparison of the properties of the two substances partly shows the reason:

	Tech. Amyl acetate	Adronol acetate
B. P. Range	80-140°C	170-173°C
Flash point	25°C	58°C
Sp. gr. at 15°C	0.855-0.860	0.9744
Molecular weight	"	142
Ester number	"	394

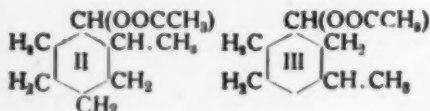
In other words, the adronol acetate appears from the data to be a specific and uniform substance, whereas the amyl acetate is usually a mixture of quite a number of esters. Adronol acetate is an excellent solvent of cellulose nitrate and will stand dilution with organic non-solvents. It leaves a clear tough elastic cellulose nitrate film on

evaporation of solutions containing the same. It is also known as *Hexalin acetate*. It is a colorless mobile fluid having an odor resembling that of amyl acetate. It is, chemically speaking, *cyclohexanol acetate* (Formula I), as evidenced by its molecular weight (142). A near relative

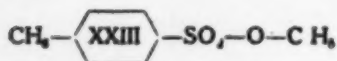


of this material is the *methylhexalin acetate*, which is a mixture of the acetic acid esters of the three isomeric hexahydrocresoles (formulas II, III, & IV) (methylcyclohexanols.) The properties of the methylhexaline acetate are as follows:

B. P. 175-190°C.; Flash point 65°C.; Sp. gr. at 15°C. 0.941; molecular weight 156; ester number of pure product 359. Its solvent action on cellulose nitrate is as the *adonol acetate*.



*A.E.P.* (Plasticizer). This proved to be *ethyl paratoluenesulfonate* (formula XXIII), molecular weight 200. It appears in commerce in comparatively large colorless crystals melting at 31°C-32°C. has a neutral reaction and a pleasing odor and is easily soluble in most organic solvents. It is however somewhat poisonous, and should therefore be handled with considerable care. Its ester number is 280, and flash point 158°C. As a solvent and plasticizer for cellulose nitrate it is equal to camphor.

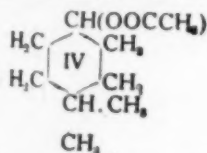


*Anon* (Solvent) it is mainly cyclohexanone, which see *Benzyl benzoate*, see under *Ergol*.

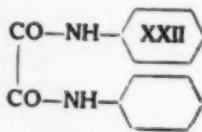
*Butanol* (Diluent). The normal (primary) butyl alcohol,  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$ . This is the basis of butyl acetate (bu-

tanol acetate), and while not a solvent of the cellulose esters finds wide application as an addition to lacquers and cellulose ester compositions. It is only partly miscible with water, 15 parts of the latter being required to form a clear solution. B.P. 114-117°C.; Flash point 34°C.; Sp. gr. at 15°C. 0.8145-0.8175; Molecular weight 74. Its main use is in cellulose nitrate lacquers.

*Butanol acetate* (Solvent). This ester is the acetic acid ester of the normal butyl alcohol and has the formula  $\text{CH}_3\text{COOCH}_2\text{CH}_2\text{CH}_2\text{CH}_3$ . It has a color-gr. at 15°C. 0.8874; Molecular miscible with water. B. P. 121-127°C., Flash point 25°C. Sp. weight 116. It is a most excellent solvent of collodion cotton and of celluloid,



*Butyl acetate* (normal) (Solvent) see Butanol acetate iso-*Butyl acetate* (*Tamasol J*) (Solvent). This product is sold in Europe under the name of "Tamasol J" and has the formula  $\text{CH}_3\text{COOCH}_2\text{CH}(\text{CH}_3)_2$ . Its boiling point is between 106 and 117°C., Flash point 18°C.; sp.gr. at 15°C. 0.8685. It is a colorless fluid non-miscible with water, boils ten degrees lower than the normal butyl acetate and is an excellent solvent for cellulose nitrate and celluloid. It evaporates faster than the normal butyl acetate.



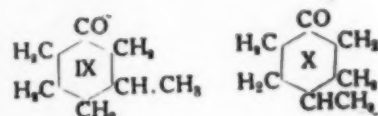
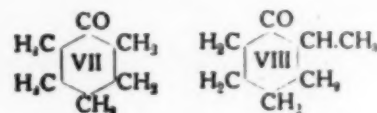
*Butyl alcohol*, see Butanol.

*Butylethyl carbonate*, (Solvent), see Ethylbutyl carbonate.

*Camphol* (Plasticizer). This, on examination, was found to be *Oxanilid* formula XXII, having a molecular weight of 240. It is a colorless crystalline substance melting at 245°C and boiling at 320°C.

*Cresol paratoluenesulfonate* (plasticizer), see KP.

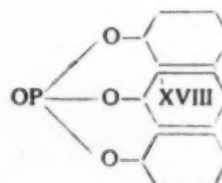
*Cyclohexanone and Methyl cyclohexanones* (Solvents). These two compounds are also known as *Anon* and *Methylanone* respectively, and are both solvents of cellulose nitrate, celluloid and cellulose acetate. (See Formulae VII-X). They are



colorless liquids, mobile, neutral, have an odor reminiscent of acetone and peppermint, and are practically insoluble in water. Their respective properties are:

	Anon	Methylanone
B. P. Range	160-156°C	165-171°C
Flash point	44°C.	48°C.
Sp. gr. at 15°C.	0.9543	0.9266
Molecular weight	98	112

The methylanone is really a mixture of the three isomeric methylcyclohexanones (Formulae XVIII, IX and X). Both products are found in the trade in a high degree of purity. Their main use is in lacquers and coating compositions. Formula VII is that of the material known as *Anon*.



*Cyclohexenone*, (Solvent) see under *Dioxane*.

*Cyclohexyl adipate* (Plasticizer). This substance, which is the cyclohexyl ester of adipic acid (Formula XX), molecular weight 310, has recently appeared on the market as a cellulose ester plasticizer. It is in the form of a white crystalline material melting at 38°C, having an ester value of 361. The technical product, according to its degree of purity, boils between 315 and 325°C. It is neutral in reaction, insoluble in

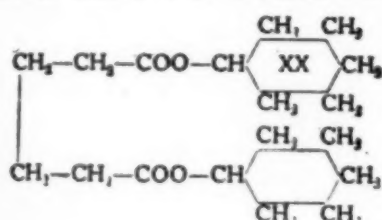


water, readily soluble in most organic solvents, almost odorless and virtually non-volatile. Its flash point was found to be 196°C.

*Dibenzyl ether*, see under Ergol.

*Dibutyl phthalate* (Plasticizer) see under palatinol.

*Diethyl carbonate*. (Solvent).  $\text{CO}(\text{OC}_2\text{H}_5)_2$ . This is a water white liquid with a not unpleasant odor, miscible with the usual organic solvents but only slightly soluble in water. The physical properties are: B. P. 120-130°C; Flash point about 25°C; Sp. gr. at 15°C.=0.9760; Molecular weight 118; ester number of the pure compound 949. By itself it is not a good solvent of cellulose esters, but when mixed with alcohols and



*Diethyl diphenyl urea*, see Mollit 1.

*Diethyl phthalate* (Plasticizer) see under Palatinol.

*Dimethyl phthalate* (Plasticizer) see under Palatinol.

*Diphenyl diethyl urea*, see Mollit 1.

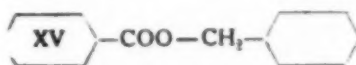
*Dioxan and cyclohexenone*. (Solvents). Two further solvents both for cellulose nitrate as well as cellulose acetate are the 1,4-dioxane and the  $\text{d}_2$ -cyclohexene-1-one. The molecular weight of the first is 88, and that of the second 96. 1,4-dioxan is a colorless pleasant smelling liquid having a boiling point of 100°C, and is characterized by being miscible both with water and with the usual organic solvents. Dioxan solidifies at +9°C., and besides its solvent power is also endowed with the property of wetting very thoroughly such objects as it comes into contact with. The related  $\text{d}_2$ -cyclohexene-1-one is likewise colorless, has an odor reminding one of peppermint. Its boiling point is 155-

165°C; flash point 34°C., and sp. gr. at 15°C. 0.985. (See formulae 5 1,4 Dioxan and 6 cyclohexene-1-one).

*Elaol* (Plasticizer), see Palatinol C.

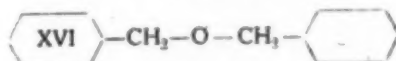
*Erganol*, see under Ergol.

*Ergol*. (Plasticizer). Under this name a plasticizer and high-boiler is found on the market. It consists essentially of *benzyl benzoate* (Formula XV), mole-



cular weight 212. It is a colorless, highly refractive water-insoluble substance having the following properties: B. P. 345°C; Flash point 148°C; Sp. gr. at 15°C. 1.121; Ester number 264.

Another similar product sold under the name of *Erganol* was found to consist essentially of *dibenzyl ether* (Formula XVI),



having a molecular weight of 198. It consists of an odorless, colorless, refractive liquid, insoluble in water and with the following properties: B. P. 298-300°C; Flash point 135°C; Sp. gr. at 15°C. 1.035.

*Ethyl acetanilid*, see Manol.

*Ethyl acetate*, (Solvent) see under Acetic acid esters.

*Ethylbutylcarbonate* (Solvent).  $\text{CO}(\text{OC}_2\text{H}_5)(\text{OC}_4\text{H}_9)\text{CH}_2\text{CH}_3$ . This is a water white fluid having the following properties: B. P. 135-175°C; 15°C. 0.9365; Molecular weight 146; ester number of pure compound 767. It is but slightly soluble in water but miscible with all other organic solvents. It differs from diethyl carbonate in having a higher boiling point, and is mainly used as a mutual solvent in order to make possible the combination of cellulose esters with other materials not easily combined therewith.

*Ethyl glycol*, see Glycol ethers.

*Ethyl glycol acetate*, see under Methyl glycol acetate.

*Ethylglycol phthalate*, see PA.

*Ethyl para-toluenesulfonate*, see AEP.

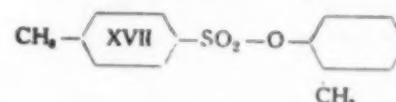
*Formic acid esters*, (Solvents). see under Acetic acid esters.

*Glycol ethers*. (Solvent). *Methyl glycol*,  $(\text{OH})\text{CH}_2\text{CH}_2\text{OCH}_3$ , as well as the corresponding *ethyl glycol*  $(\text{OH})\text{CH}_2\text{CH}_2\text{OC}_2\text{H}_5$ , are colorless, neutral mobile liquids, miscible with water in all proportions. They have a slight, not unpleasant odor, and are uniform definite substances. The methyl glycol is an excellent solvent for cellulose nitrate, celluloid and cellulose acetate; whereas the ethyl glycol only dissolves pyroxylin (collodion cotton and celluloid). Their use is mainly in making odorless pyroxylin lacquers. Solutions of the cellulose esters in these glycols form transparent and clear films, and may be considerably diluted with alcohol, benzene or butanol. The properties of the two glycols are as follows:

	Methyl glycol	Ethyl glycol
Boiling point range	115-130°C.	126-138°C.
Sp. gr. at 15°C.	0.9712	0.9382
Flash point	36°C	40°C
Molecular weight	76	90

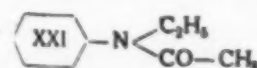
*Hexalin acetate* (Solvent) see under Adronol acetate.

*KP*. (Plasticizer). A product sold simply under the name of KP proved to a *cresol para-toluenesulfonate* (Formula XVII), having a molecular



weight of 262, ester number 214. It consists of a brown oily liquid having a slight odor, readily soluble in the usual organic solvents as well as in cellulose nitrate solvents, proving to be an excellent gelatinizer of the cellulose ester. Its sp.gr. at 15°C. is 1.207; and its flash point 184°C.

*Mannol* (Plasticizer). This is *ethyl acetanilid* (formula XXI). Its molecular weight is



(Continued on page 504)



# How Will Your Product Stand Up Under Heat?

A standardized method of examining molded products, known as the "Martens test" gives the most reliable indications of the expected behavior of any given article

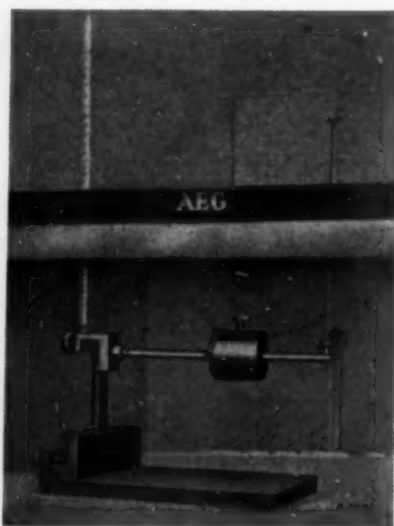
By Dr. Ing. Arthur Sommerfeld

of the Suddutsche Isolatorenwerke, Freiberg: Br., Germany

ABOUT twenty years ago there arose a demand among the producers of electrical apparatus for a reliable method to determine the resistance of the molded parts then being produced to deformation by heat. Although a few really heat-resistant materials were available, there were, nevertheless, a large number of articles on the market that were so prone to deformation and warping when they became even slightly heated, that electrical apparatus equipped therewith soon became practically useless. The result was that at first the molded materials, other than those made of hard rubber, acquired a rather dubious reputation. Some of the materials were so fusible that they would even soften under the influence of sunlight. As a result of considerable agitation, a number of German industrial concerns catering to the electrical industry got into communication with the official governmental testing laboratories, such as the Physikalisch-technische Reichsanstalt (Physical-technical government experiment station) and the Official German "Material-Prüfungsammt", which latter corresponds in scope to the United States Bureau of Standards.

## How the Test Evolved

In co-operation with these laboratories, the producers of molded insulation furnished a large number of test pieces of various products, and work on standardizing the methods of



Standard Martens test apparatus for determining deflection of plastics when heated.

testing were begun. The results of this work were published in 1912 by Dr. H. Passavant, who was at that time the director of the Berliner Elektrizitäts-Werke (Electrical Works), appearing in the German publication known as the *Elektrotechnische Zeitschrift*.

The entire investigation was predicated upon the thought that it was essential, in order to obtain strictly comparable results, to test samples of the same shape and contour. The conclusions arrived at led to the adoption of a test that had been devised by Professor Martens, at that time the director of the Material-Prüfung-Amt. This test gave very accurate and sharply defined numerical data from which logical conclusions

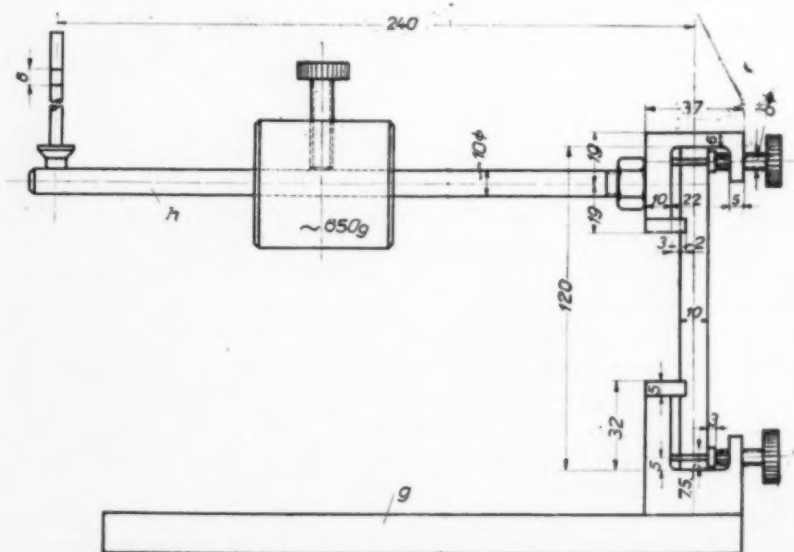


Fig. 1. Side elevational view showing dimensions and details of standard apparatus

as to the suitability of a given molded material could be deduced. Hence the name "Martens-test."

The test is carried out according to the description and specifications laid down by the Association of German Electrotechnicians, and published

and subjected to a steadily increasing temperature. The increment in temperature should be  $50^{\circ}\text{C}$ . per hour. The numerical data sought after is the "Martens Degree", designated as "A m". This is the temperature at which the lever  $h$  sinks down or bends 6 milli-

usually give quite closely agreeing figures. This enables a manufacturer to assure himself that a given batch of molding material will have the resistance to heat prescribed in a specification, and also makes it possible for a designer to specify what type of material is to be employed for a given molded article.

### Interpretation

It is a fact, however, that the actual finished molded objects will nevertheless differ somewhat in their softening point and other physical characteristics from the uniform test pieces, as the shape and configuration of the articles is a contributing factor that is not without considerable influence. The heat and amount of pressure used in molding the insulating material also may be somewhat different from that

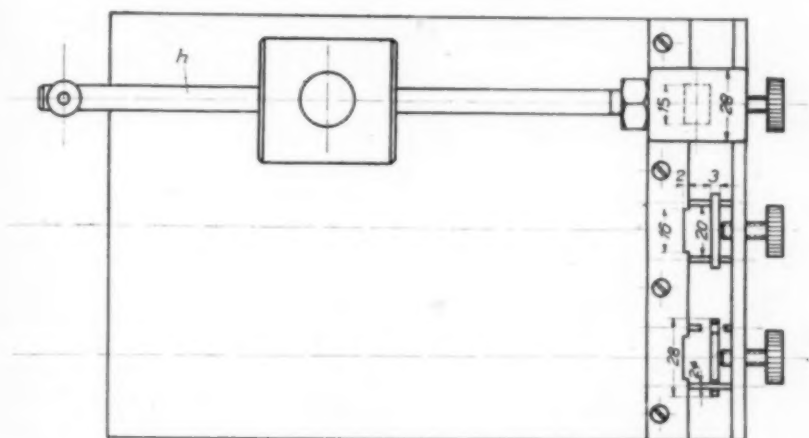


Fig. 2. Top plan view of Martens apparatus.

by the Verein deutscher Ingenieure as their Bulletin No. 318. While the test is to be applied to all electrical insulating materials, it should not be forgotten that it was developed primarily for testing molded materials, even though they were derived from hard rubber.

### The Test-piece

The test-piece required for the determination of stability in presence of heat, takes the form of a rod having a rectangular cross-section of exactly 10 by 15 millimeters and a length of 120 millimeters. The resistance to heat of this is determined by three successive tests in a standard apparatus, about to be described. The construction of this apparatus is shown in the illustrations (fig 1 and 2).

The test-piece is supported by clamps in a vertical position upon the foundation plate  $g$  (see fig. 1) and is subjected to a constant bending strain equal to 50 kilograms per square centimeter of cross-section by the weighted lever  $h$ , which carries a sliding weight of 650 grams while the entire apparatus is housed in a heating chamber

meters at a point 240 millimeters from the point of support, or when the sample actually breaks, which sometimes occurs.

In further explanation the following directions for carrying out a Martens test on a piece of insulation are given:

The test is primarily a control test, and gives figures that allow a proper estimate as to the suitability of a given insulating material for a certain purpose to be arrived at. It is capable of accurate reproduction, and duplicate samples

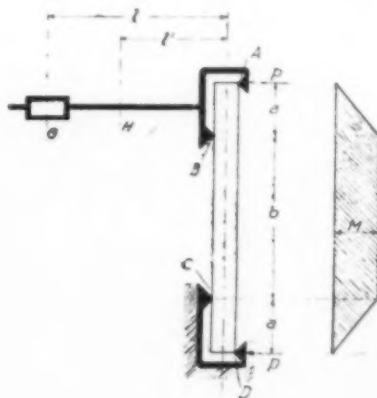


Fig. 3. The forces brought to bear on the test pieces are visualized by the above diagram.

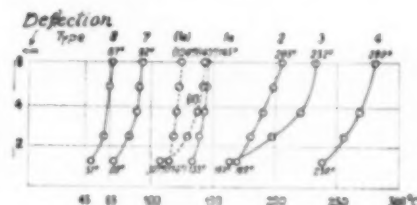


Fig. 4. Characteristic curves plotted from data obtained in testing commercial samples of molded insulation.

used in making the test piece and these factors must be taken into consideration when interpreting the results of the Martens test. It is therefore important to also carry out a test with one of the finished objects, provided that the same is of such shape that it will lend itself to such an operation. The Association of German Electrotechnicians is engaged at present at Nuremberg in working out standardized tests for the examination of actual finished molded objects.

Thus it will be seen that with all its accuracy, the heat test is only one of the physical tests that can be applied to a given molded part, but is an essential

(Continued on page 506)

# Physical Properties of Cellulose Plastics Dependent on Mode of Manufacture

How various types of celluloids and acetate products differ from each other

By O. Manfred and J. Obrist

A communication from the German Technical High School at Brunn, Czechoslovakia

THE materials described in the August issue of *Plastics* (Celluloid, acetyl cellulose, vulcanized fiber, Monite and Trolite) were subjected to tests to determine the modulus of elasticity. The samples were in the form of plates as well as of rods. In the case of these cellulose plastics however, there was no marked difference in behavior between the plates and rods, as had been found in the case of casein plastics and resinoids. We did not find any marked differences in the different samples which were taken from different places in the larger samples from which the test pieces were cut. As in the case of the cellulose plastics there is far-reaching chemical as well as mechanical plastification, which is not at all surprising. In the case of paper and cardboard however, differences in mechanical strength along different directions was found, and the effect of streaming of the materials exerted its usual and expected effects.

## Average Results

The samples examined were in the form of plates 50 centimeters square, and rods 1 meter long. About fifty determinations were made, the results given below representing an average of all. In order to show the connection between mechanical working (plastification) and the elasticity of the resulting products, the materials are enumerated in the order of decreasing elasticity.

*In the August issue, the materials whose behavior under different conditions is described in the present article, were enumerated, and their origin and methods of manufacture explained.*

*The elasticity of the cellulose ester plastics as related to the process of manufacture and the type of plasticizers employed forms the theme that engages the attention of the authors. It is shown, on the basis of numerical data, that as the amount of plastification or mechanical working decreases, the modulus of elasticity increases, i. e. the elasticity becomes less. The present article is the conclusion of the series by the authors. As already pointed out the articles originally appeared in our German contemporary, the "Kolloid-Zeitschrift", and they have been translated from reprints kindly furnished us by the authors.*

The materials employed for this investigation were practically all without fillers and transparent, or had merely been colored with soluble dyes, so that their true mechanical properties were sharply defined. In the case of the pyroxylin plastics (celluloids) examined, the following table shows the modulus of elasticity:

Maker	Modulus of Elasticity in terms of Kg. per sq. cm.
Westfälisch-Anhaltische Sprengstoff A.-G.	2,500
Zelluloid-Fabrik Speyer	4,500
Rheinisch-Westfälische Sprengstoff A.-G.	6,300
Westfälisch-Anhaltische Sprengstoff A.-G.	7,000

The great disparity between the results of celluloids made by these different manufacturers can only be accounted for by the influence of the different kinds of chemical plasticizers employed; these acting either to peptize the cellulose ester particles or to coagulate the same; although the temperature at which the cellulose was nitrated may have been partially responsible for the results. Brandenburger and Mark (*Kolloid-Zeitschrift* 1924, 34, 12) have examined the elasticity of cellulose nitrate both with and without the addition of camphor, and have found that the toughness of the cellulose nitrate, which is greatest in case of the pure material, decreases regularly with increasing camphor content, while at the same time a lowering of the modulus of elasticity occurs. When 35% of camphor has been reached, however, the toughness again increases, although the modulus of elasticity shows a remarkable constancy. This demonstrates that at 35% camphor content the plastification of the cellulose nitrate by the camphor has reached its maximum.

## Differences Explained

Based on these considerations it appears likely that the difference in the figures may be  
(Continued on page 498)





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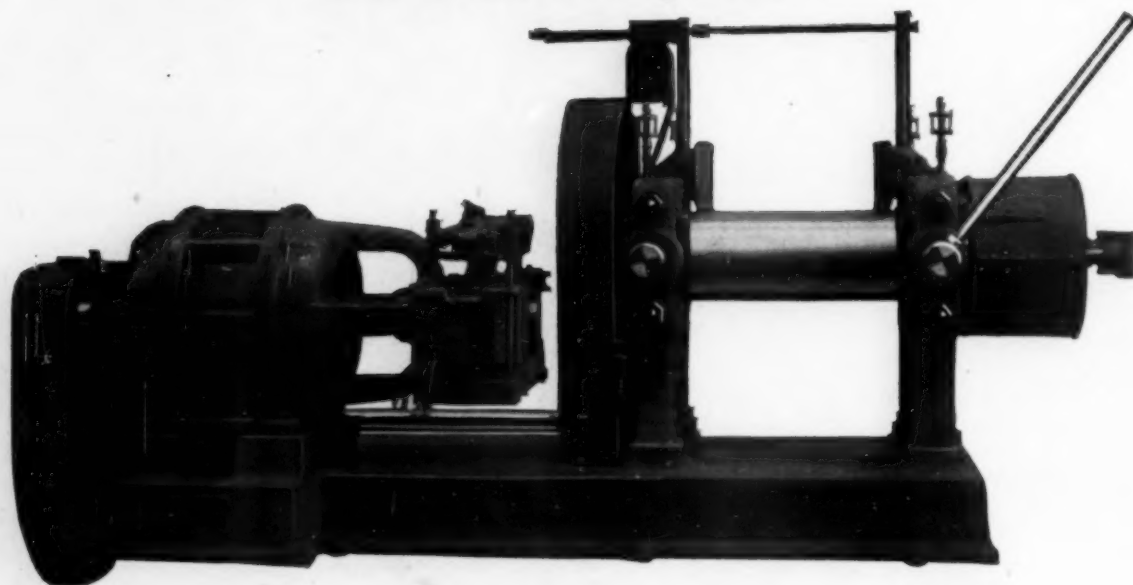
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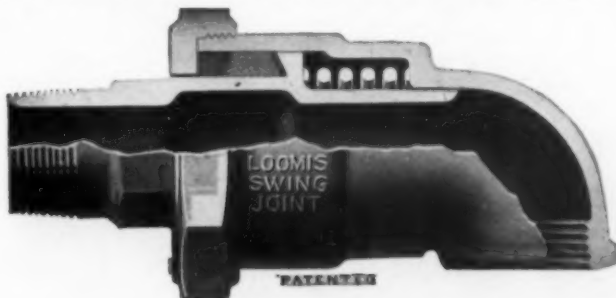
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(Continued from page 494)

caused by too small an amount of camphor or by the addition of other fillers or modifiers that partially neutralize the plastifying power of the camphor. In practice, in order to obtain harder products, this is sometimes done deliberately. A list of materials that may be used for modifying the properties of celluloids has been compiled by Schmidt and published in *Kunststoffe*, 1924, 14, p. 129, 167 and 184. The effects of additions tending to harden the celluloid are plainly brought out in the last sample on the table (7,000) which was a sample of "Ivory" filled with mineral coloring matter.

As contrasted with the pyroxylin samples, the cellulose acetate plastics have a higher modulus of elasticity, never approaching the high elasticity of the grst sample of the former. For example:

**Modulus of Elasticity of Cellulose Acetate Plastics**

Zellon	6,000 kg. per sq. cm.
Sicoid	5,000
Rhodoid	
(rod)	5,000
Rhodoid	
(plate)	3,500

In connection with the samples of Rhodoid it should be pointed out that they were not of the same batch of material, and that the plasticizers in the two samples were different. As the mechanical production features of the cellulose acetate plastics are exactly the same as those of the pyroxylin products, the effect of degree of dispersion of the two cellulose esters, and the resultant effect on the final plastic products, become clearly apparent.

Vulcanized fiber is produced by the superficial gelatinization of paper fiber, and there is none of the far-reaching dispersion that occurs in the case of cellulose nitrate and acetate, especially during the washing or grinding of the former. Consequently, as would be expected, the elasticity of the vulcanized fiber is lower, being express-

## Goldsmith's Casein Plastics

### Early attempts to mold proteid materials depended on plasticizers

*IN the August issue the early efforts of Byron B. Goldsmith on the production of casein solids was delineated. He used amines and similar compounds to produce a moldable composition—even going so far as to make a phonograph record. The article is continued here.*

It will be noticed by the informed reader, that thus far Goldsmith has not made use of any indurating agent to limit the solubility of the casein. Apparently his attention must have been directed to the value of formaldehyde in this connection, probably by the success then being attained by the Germans in producing Galalith under the Spitteler patents. Thus in the

ed as a higher modulus of elasticity. Two samples examined showed a value of 13,500 and 25,000 kg. per sq. cm. respectively. The difference between the two samples was probably caused by the difference in comminution of the paper from which they had been made. (In this connection see *Rev. mat. plastiques*, June 1925, p. 109, and German Patent 376, 384 of the Köln-Rottwel A.-G.).

Trolite, regarding the manufacture of which we have little information was next examined. It has a high modulus of elasticity, 33,000 kg. per sq. cm., and a modulus of rupture of  $S_{max}$  300 kg. per sq. cm. This plastic substance is not at all pliable, and probably contained large amounts of fillers, and had received an addition of gelatinizing agents. This material behaves somewhat like the proteinoplastics, especially such as are made from casein by molding operations.

#### Hard Rubber

When one contrasts with the figures enumerated the modulus of elasticity of hard rubber, which is as low as 2,400 kg. /sq. cm., it becomes evident that celluloid closely approaches this material in its elastic behavior. According to LeBlanc and Kröger (*Gummi-Zeitung* 1926, 40, 783, 1803) this can be account-

ed for in the case of the rubber by the vulcanization, which acts as a re-aggregating agency.

Paper differs so much in its origin and treatment that it would be of no interest to present numerical data, although we can say that the effect of dissaggregation and reaggregation in paper products was found to exert the effects that we have been able to demonstrate in the case of the plastic materials.

With the above description of the behavior of the cellulose ester and cellulosic plastics, our work in this field, for the present, is completed. We have shown in previous articles that the effect of dispersion and re-aggregation play a very important factor in the determination of the mechanical and elastic properties of plastics.

A resume of our findings has appeared in previous issues of *Plastics*.

In conclusion we wish to express our thanks and appreciation for the assistance given us by Prof. Dr. E. Lohr, head of the Physical Institute of the German Technical High School at Brunn who displayed great interest in our investigations; and also to the above enumerated firms who have supplied us with the necessary samples to carry out the work.

following year, in his patent 964,964, July 19, 1910, Goldsmith for the first time mentions formaldehyde in connection with his plastics, this patent however dating back to 1907, when he applied for it. Here he states that he has discovered that formaldehyde or its equivalent has the effect of correcting certain undesirable tendencies apt to follow the use of the converting agents. He gives the already well known list of these.

In this patent he gives two general methods. The first contemplated making the thermoplastic casein compound as usual by incorporating the organic plasticizer, followed by treating the sheets or molded articles with formaldehyde to harden the same, either as gas or solution. A further molding, under heat and pressure could follow. The second method involved adding both the converting agent and the formaldehyde to the casein at the same time. A second patent, issued on the same day, applied the process just described to vegetable proteids, a converting agent and formaldehyde, being patent No. 965,137; June 19, 1910.

#### Used Formaldehyde

Apparently Goldsmith knew about formaldehyde as early as 1907, for the patents just mentioned, and several of those about to be described, were divisions of his patent filed October 7, 1907, (No. 923,353). Some of these divisional applications matured into his patent No. 1,027,121, and 1,027,122, both May 21, 1912. The first of these covered an indurated albuminoid compound in which the hardening with formaldehyde preceded the plasticizing. The second is directed to casein and specifies that four pounds of casein, which has been treated while still in the moist curd stage by means of formaldehyde, is mixed with a half pound of beta-naphthol, following

(Continued on page 512)

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# One Way of Making Multi-Colored Blocks of Resinoids

Difficulties of obtaining clean-cut joints between different colored layers easily solved

THE cigarette holders and other smoker's articles that have come onto the American market within the past few years very often consisted of apparently fused together pieces of differently colored hardened transparent or opaque phenolic resins. The usual process of producing such pieces was first to create a block or slab by carefully cutting pieces of colored hardened resin and then cementing them together in order to produce the variegated blocks.

Max Hilfreich, of Vienna, in Austria, overcomes the defects in the old process of producing such differently colored blocks by the comparatively simple expedient of first forming pieces of colored hardened resin and then casting some of the still fluid resin around them, whereupon he hardens the entire mass, thus imbedding the colored pieces.

## A Casting Process

He has had the process patented; U. S. P. 1,668,590; May 8, 1928; and, on the face of the patent, the process has not been assigned to any one in this country. After describing the older process, along the lines above indicated, Hilfreich proceeds to say that contrary to this binding method, the process according to the present invention consists in a casting process and the essential feature of the same consists in that suitably colored artificial resin, preferably in the shape of plates, is surrounded with artificial resin in a liquid condition, which if desired may be in a colored state and the product is hardened in the usual manner.

Several modes of carrying out

*The method in essence, consists in making hardened slabs of resin and pouring reactive material around them, finally hardening the entire mass.*

*The process has utility especially in making smoker's articles, toilet-ware and the like.*

the present invention are illustrated by way of example.

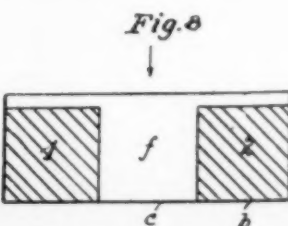
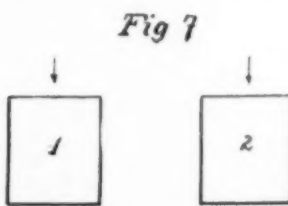
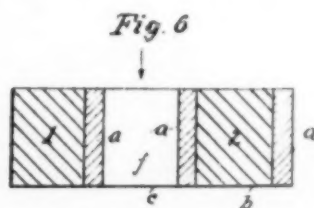
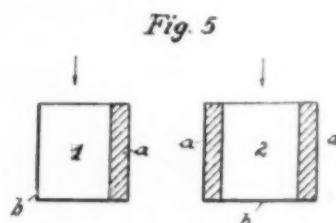
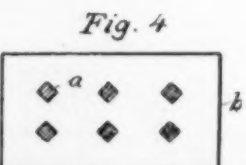
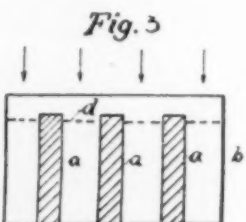
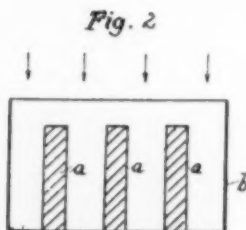
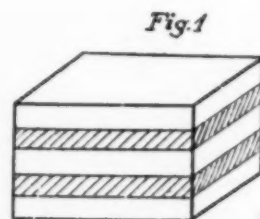
Fig. 1 shows a block of artificial resin, which is composed of a number of colored layers

Figs. 2, 3 and 4 illustrate the process when working with one mold only.

Figs. 5 and 6 show a method where two individual molds are used and

Figs. 7 and 8 a further mode of the process in which two individual molds are applied.

For instance if it is desired to produce a block composed of a number of layers and in which every second or alternate layer is to be of the same color, at





first plates of the desired thickness are cut from differently colored blocks of artificial resin. Hereafter these plates *a* (Fig. 2) are inserted in a sheet-metal mold *b* of the required form. The various plates are held in position by suitable projections of the sheet-metal mold, and now artificial resin in a liquid condition and of one color is poured between the individual plates in the direction of the arrows. The block is hardened in the usual manner and finally the sheet-metal mold is torn open.

#### Different Possibilities

However it is not necessary to insert in the mold whole plates, pieces of artificial resin of any other shape may be introduced into the molds. These pieces *a* may be arranged in the manner shown in plan view in Fig. 4. In this case an appropriate means such as a network *d* or the like (Fig. 3) may be employed for securing the pieces, the top ends of the latter being fixed by the meshes of the said network. The artificial resin in a liquid condition is poured in through the meshes of the network, and hereafter the hardening operation takes place.

If it is desired that all the plates are of different colors, the method according to Figs 5 and 6 is resorted to, whereby two part-molds 1 and 2 of a composite mold are employed. As illustrated for instance the part-mold 1 may consist of a sheet-metal casing with one of the side walls removed, whereby the latter is replaced by an artificial resin plate *a*, which is tightly fitted in the mold. The part-mold 2 consists of a sheet-metal casing provided with two tightly fitting side walls *a* of artificial resin, which are disposed opposite one another, these part-molds are hardened and, as shown in Fig. 6, are united with one another at the base by sheet-metal *e*, for instance by soldering. Also the side walls of the molds 1 and 2 are united with one another by means of sheet-metal plates, so that a hollow space *f* is formed

between the molds 1 and 2, the same being filled with resin in liquid condition and subsequently hardening takes place.

However according to the present invention there is no need of cutting plates at all. In this event artificial resin in a liquid condition is poured into the molds 1 and 2 (Fig. 7) and hardened. Now a side wall is removed from each sheet-metal casing and the base and side walls are united by soldering sheet-metal plates *C* (Fig. 8) to the casings. Thereby care is to be taken, that the side faces of the blocks, from which the sheet-metal sides have been removed, face each other. Now resin in a liquid condition is poured into the clear space between the blocks 1 and 2 and is hardened. In this manner a block is produced, which consists of three differently colored layers, the employment of plates being dispensed with.

The problem of a simple and inexpensive manufacture of artificial resin blocks composed of a number of layers is satisfactorily solved by the casting process as described in combination with the employment of auxiliary sheet-metal molds. The faces of the individual layers are distinct, and transparent intermediate layers cannot

arise at the borders of the colored layers, because an agglutinant is not employed. The process according to the present invention is also less expensive than the known sticking method, fewer plates are employed as heretofore and therefore the loss of material caused by "pre-cutting" the plates is materially reduced and can be dispensed with entirely, because the blocks may be produced without the use of plates. The plates do not require to be ground smooth and they cannot get shifted or displaced with respect to one another, because they are bordered by firm walls. Further also the application of pressure is dispensed with. The saving of material and work is quite obvious. Extra costs only arise for the manufacture of the sheet-metal molds for every individual block. However these expenses are very small, because the tin-plate used for preparing these molds may be very thin and is at disposal in the factories occupied with the manufacture of artificial resin in the form of the tin-plate drums in which the carbolic acid is usually furnished. As compared with the sticking method between 30 and 40% are saved by the process according to the present invention.

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A. C. Newman

May 31, 1928

# Great Activity in the Field of New Resins

Never before in the history of the art of making resinoid products has there been a larger number of new processes described in so short a space of time. The condition speaks well for the future of plastic and molded materials

By Carl Marx

**T**HE growth of the synthetic resin, or "resinoid" art as it is now called, is at present unbelievably rapid, and the research work being done is truly remarkable, and apparently of enormous extent. There has not been a single issue of the Official Gazette of the United States Patent Office during recent months that did not contain from one to as high as ten patents in this field—and the Gazette appears every Tuesday!

Were we to reprint, only in very condensed form, all of the patents that issue along these lines, we could fill a magazine twice the size of PLASTICS every month. By giving only the most essential outlines in our Patent Review section, where we now also report the British patents, we at least partly manage to keep up to date; but even then the limitations of space, and the necessity of devoting much of it to other interesting and pertinent matter compels us to keep our readers informed of the progress realized by a review every few months or so, covering the most important United States patents in this prolific field.

The present review covers the period between April 10 and June 12th, 1928, or only two months, yet it includes twenty patents.

**T**WENTY patents on resinoids in the space of 8 weeks! That is the pace being set by our modern inventors in the field of synthetic chemistry, covering the United States patents only. When it is remembered that by far most of the patents about to be described were applied for from three to four years ago, so that the research work actually was done that far back, it can readily be imagined how busy the laboratories of today are with these and allied problems. There can be no doubt but that this pace will be far exceeded in the future. To keep abreast of these developments, and to keep our readers aware of the latest disclosures is the object of these periodic reviews in our pages.

In order to make it easy to refer back to any one patent of more interest to the reader, the patent number, date, inventor and assignee is given at the be-

ginning of the description of each invention, in the fashion we have adopted in our Review section.

## The Miner Laboratories Contribution

Four patents issued to the workers at the Miner Laboratories, in Chicago, where the research work on furfural and its derivatives is being carried on in behalf of the Quaker Oats Co., to whom the patents are assigned. Among these patents there are the following:

**1,665,234. April 10, 1928. John P. Trickey and Carl S. Miner. Process of Making Furfural Resins.** This relates to a pure furfural resin, i. e. one made from this material alone, without condensation with a phenol or the like. The process comprises heating furfural or other furane derivative under

pressure with a metallic catalyst, such as iron, nickel, lead, magnesium, zinc, or tin; preferably in the finely divided form, although the process may be carried out merely in containers made of these metals, provided that rapid agitation of the furfural is produced. The products form soluble and fusible resins, which, however can be converted into the insoluble-infusible stage.

**1,665,235. April 10, 1928. John P. Trickey and Carl S. Miner. Furfuralcohol Resins.** This patent relates to the production of a resin from furfuralcohol alone, by treatment with an acid catalyst. The process will be described in full in this or an early issue, as it involves a number of very interesting features.

**1,665,236. April 10, 1928. John P. Trickey and Carl S. Miner. Obtaining Furane Derivatives.** The process covers the formation of a resin from furfural, furfuralcohol and pyromucic acid, the latter however produced from the furfural by treatment with sodium hydroxide, so that in effect it is a controlled process of producing a resin from furfural alone. Furfural is treated with sodium hydroxide solution forming furfuralcohol and sodium pyromucate, this being done at a temperature not to exceed 15°C. After the first reaction stage, forming the above substance, the sodium hydroxide is neutralized with sulfuric acid until the mixture is slightly acid to Congo red. After more or less complete separation of the sodium sulfate

formed, and a little of the free pyromucic acid likewise produced, the mixture is heated to from 80-110°C, care being taken to avoid heating above 110°C, refrigeration being used to keep the reaction within bounds. The action of the acid produces pyromucic acid which thereupon condenses with the furfuralcohol and with any furfural still remaining to form the resin. Pyromucic acid forms one of the valuable by-products.

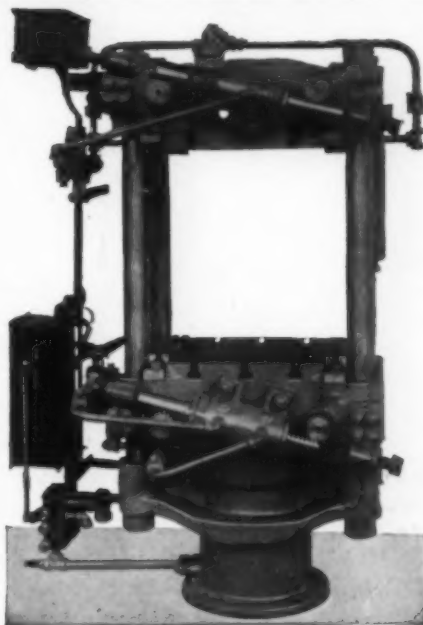
1,665,237. April 10, 1928. John P. Trickey and Carl S. Miner. Resinous Substance and Making the Same. This also covers a resin made by starting from furfural alone, without the use of phenols. The product is very plastic and hence readily lends itself to the addition of fillers. The process comprises mixing furfuralcohol with furfural and causing condensation to take place by the addition of catalysts, or by heating, or both. Hydrochloric acid, in the amount of 1/10% of the weight of the reaction mixture, and a temperature of 80°C. is recommended. As in patent 1,665,236, pyromucic acid is produced, and enters the reaction product, although some of it is also recovered as a byproduct.

#### The DuPont Interests

The E. I. DuPont de Nemours Co., appears also to be entering the field of synthetic resins, thus showing that the producers of pyroxylin plastics are not letting the resin workers get a jump ahead of them. The following patent, 1,667,189, is assigned to them.

1,667,189. April 24, 1928. Charles E. Burke and Horace H. Hopkins. Synthetic Resin. While this resin is intended mainly as a constituent in lacquers, it is stated to become insoluble extremely rapidly at elevated temperatures. The patent depends somewhat upon a co-pending application filed Aug. 14, 1926, and relates to resins produced by the interaction of pentaerythrite, phthalic anhydride and the free fatty acids

(Continued on page 514)



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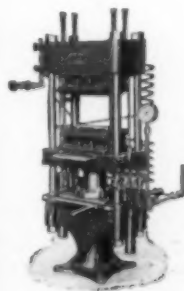
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# Modern Cellulose Plastic Modifiers and Solvents

(Continued from page 491)

163. It is a white crystalline body melting at 52°C, boiling point 250°C, and flash point 108°C. It possesses a peculiar sweetish odor, burns with a strong smoky flame, and behaves very much like camphor. It is soluble in organic solvents, and actually has much greater plasticizing power for cellulose nitrate than even camphor.

*Methyl acetate*, (Solvent) see under Acetic acid esters.

*Methylanone* (Solvent) is a mixture of methylcyclohexanones, for which see under Cyclohexanone.

*Methyl formate*, (Solvent), see under Acetic acid esters.

*Methyl glycol*, see Glycol ethers.

*Methyl glycol acetate*. (Solvent). Methyl glycol acetate,  $(\text{CH}_3\text{COO})\text{CH}_2\text{CH}_2\text{OCH}_3$ , and ethyl glycol acetate,  $(\text{CH}_3\text{COO})\text{CH}_2\text{CH}_2\text{OC}_2\text{H}_5$ , are colorless, neutral fluids having a weak pleasant esterlike odor. Whereas the methyl compound is miscible with water in all proportions, the ethyl compound is only partially miscible. As in the case of the parent compounds, the methyl compound will dissolve both acetyl and nitro celluloses, while the ethyl compound only dissolves the latter and celuloid. They will stand considerable dilution with other organic fluids, as in the case of the glycol ethers from which they are derived.

Their physical properties are:

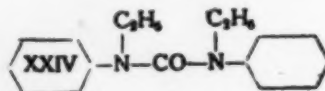
	Methyl glycol acetate	Ethyl glycol acetate
B. P. Range	130-145°C.	150-160°C.
Sp. gr. at 15°C	0.9916	0.9800
Flash point	44°C.	47°C.
Molecular weight	118	132
Ester number	474	424

*Methylglycol phthalate*, see PM.

*Methylhexalin acetate*, see under Adronol acetate.

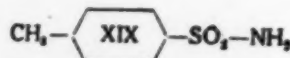
*Mollit 1* (Plasticizer). This

is a trade name for *diethyl diphenyl urea* (Formula XXIV).



Its properties are: White, well crystallized, slight odor, soluble in alcohol and in aromatic as well as aliphatic solvents, insoluble in water; molecular weight 268; Melting point 72°C; boiling point 325-330°C., flash point 150°C. When recrystallized from alcohol a number of times a purer product having a melting point of 78-79°C is obtained. It is a very excellent plasticizer for cellulose nitrate while at the same time it also acts as a powerful stabilizer, hence its use in cellulose nitrate products, such as films etc., is quite wide spread. Next to Mannol and the Palatinols it is the best commercial plasticizer at present obtainable.

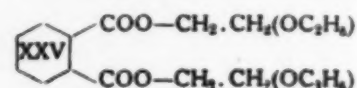
*Neo-camphrosal* (Plasticizer). This is a trade designation for *paratoluenesulfonamide*. It is a white crystalline powder melting at 135°C, soluble in organic solvents, although also soluble in hot water. It is capable of combining with alkalis. Its formula is that illustrated in formula XIX. It is a very good



plasticizer for the cellulose esters in general, although its addition is limited by reason of the fact that if used in too large an amount it tends to separate out. Its chief use is with the cellulose acetate plastics, several molding powders made from cellulose-acetate containing this substance being on the market.

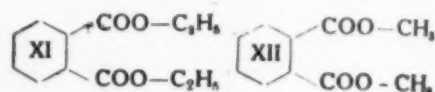
*Oxanilid*, see Camphol.

PA (Plasticizer). This is *Ethylglycol phthalate*, formula XXV. It is a colorless substance



of neutral reaction, and when molten is miscible with practically all organic solvents. Its solubilizing and plasticizing action on the cellulose esters, including cellulose acetate is very good. It boils at 233-235°C. in a 23 mm. vacuum; melts at 33°C; flashes at 173°C; has a sp.gr. of 1.1229 at 15°C, a molecular weight of 310, and ester number of 361.

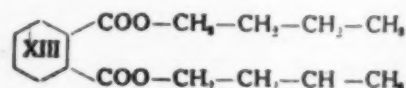
*Palatinol A*. (Plasticizer). This in all probability consists of *diethyl ortho-phthalate* (Formula XI), molecular weight 222.



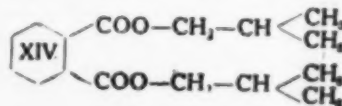
*Palatinol M* is the corresponding *dimethyl phthalate*, (formula XII), molecular weight 194. The other properties of these two related compounds are:

	Palatinol A	Palatinol M
Boiling point	298-300°C.	280, 283°C.
Sp. gr. at 15°C.	1.127	1.195
Flash point	140°C.	132°C.

*Palatinol C*, also known as *Elaol* proved to be the *dibutyl-orthophthalate* (Formula XIII), molecular weight 278.



*Palatinaol JC* being the corresponding di-iso-butyl ester (formula XIV), molecular



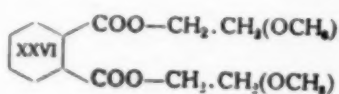
weight 278. The physical constant of the two butyl esters of phthalic acid are:

	Palatinol C	Palatinol JC
Boiling point	310-320°C.	305-315°C.
Sp. gr. at 15°C.	1.0543	1.0450
Flash point	160°C.	161°C.

The palatinols are found in quite pure form on the market and have a considerable advantage over castor oil in that they

never become rancid. Their chief use is as "high-boilers" and plasticizers of the cellulose esters, both nitrate and acetate. They are virtually odorless and practically non-volatile so that products made with the same retain their suppleness.

*PM.* (Plasticizer). This is analagous to *PA*, consisting in this case of *Methylglycol phthalate* (formula XXVI). It is a



colorless oily fluid of neutral reaction and a most excellent solvent and plasticizer for cellulose nitrate as well as cellulose acetate. B.P. 230°C. in a 10 mm. vacuum; flash point 187°C; sp. gr. at 15°C. 1.1708; molecular weight 282, ester number 397.

*Phthalic acid esters* (Plasticizers.) see under *Palatinol*.

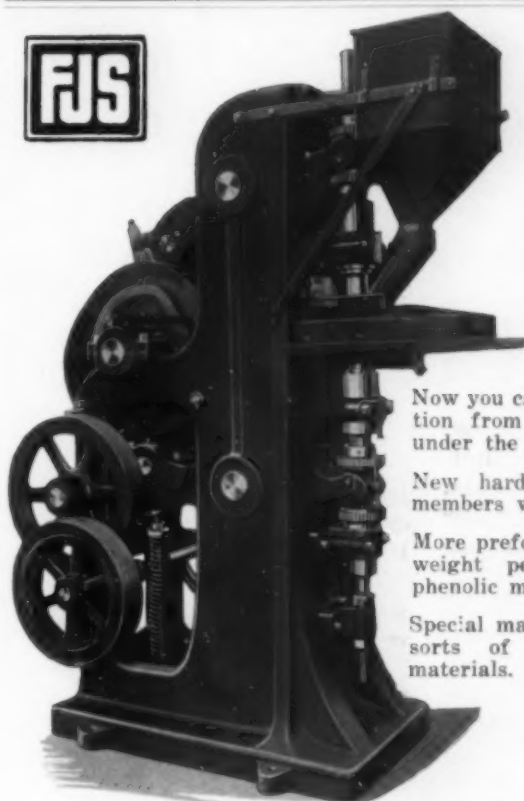
*Tamasol J.* (Solvent a trade name of iso-butyl acetate (which see).

*para-Toluene sulfonamide*, see *Neo-camphrosal*.

*Toluenesulfonic acid esters*, see *KP*.

*Tricresyl phosphate* (Plasticizer). This is the tricresyl ester of phosphoric acid, a liquid substance, otherwise endowed with properties very similar to that of triphenyl phosphate, which see. It usually consists of a mixture of the isomeric cresyl phosphates. Its flash point is about 226°C, and the molecular weight of the pure product is 456.

*Triphenyl phosphate* (Plasticizer). Among the plasticizers of the cellulose esters that is in the form of a solid at room temperatures, triphenyl phosphate is about as well known as camphor. (See formula XVIII). It is a white well crystallized substance having a melting point of 45°C. Its molecular weight is 326, and ester number 515. It is readily soluble in most organic solvents and lacquers and plastic materials made with this substance are very pliable, tough and elastic.



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# The Martens Test Described

How European manufacturers standardized on a uniform heat test

(Continued from page 493)

one for a great many electrical applications. The standard tests now adopted apply only to the highly essential determinations, and are those laid down by the Material-Prüfungs-Amt and the Physikalisch-technische Reichsanstalt. (See Passavant, *Elektrotechnische Zeitschrift* 1912, p. 450). For insulating material that is to be used at potentials above 750 volts, additional tests are necessary. These include the breakdown voltage and other determinations for details of which the reader is referred to the article above cited.

## Above Room Temperature

As many molded insulating materials are perfectly rigid even considerably above room temperatures, it becomes necessary to carry the test quite a bit beyond the temperatures that the parts are expected to be subjected to in use, in order to ascertain their qualities. Two tests have become standard, one is the Martens test, and the other a modification of the Vicat-needle test. Of these the Martens test shows up the behavior of the material under tension and bending stresses, while the Vicat needle shows the amount of penetration under pressure and shearing stresses.

## How Stress Is Applied

The diagrammatic drawing shown in Fig. 3 shows the forces that are brought to bear upon the test-piece when the same is subjected to the Martens test. As will be seen from this figure, the weight  $G$  exerts upon the lever-arm  $l$  the moment  $M = G \cdot l$ . The stress exerted upon the test-piece is the same as would be applied to it if it were

rigidly supported upon the fulcrum-points  $B$  and  $C$  and had forces equivalent to  $P$  applied to the extreme ends  $A$  and  $D$ , the point of application of the force being at equidistant points from the supporting points  $B$  and  $C$ , and designated on the drawing as distance  $a$ . The torsional force increases from point  $A$  to point  $B$ , and from point  $D$  to  $C$  to its maximum value  $M = G \cdot l$ , which later force remains constant along the entire distance  $b$  between the points of support  $B$  and  $C$ . The moment  $G \cdot l$  hence is equivalent to the force  $P \cdot a$ , so that these two stresses are equal. It is advisable not to make the leverage  $a$  too small in relation to the stress  $P$ , so that the force exerted at  $P$  will not be so great as to dent or deform the test-piece at that point. The distance  $b$  can be varied considerably without vitiating the results. However, there is a reasonable limit for the distance  $b$ , as otherwise, when the test-piece becomes distorted by the force of the weight, the lever  $H$  will be somewhat shortened in effect and the force therefore altered. A normal size for the test piece, lever, etc., has been worked out, as well as the optimum dimensions of the distance  $b$ . If the distance  $l$  is not too small, so that the weight  $G$  need not be excessive, the vertical pressure exerted upon the test piece is practically negligible. Hereinabove the active moment is simply given as the term  $G \cdot l$ , although of course the lever  $H$  has its weight, and this should be considered. In fact the moment applied to the test-piece is in reality  $M = G \cdot l$  plus  $H \cdot l = P \cdot a$ . As the weight of the lever is however constant,

no great error will thereby be introduced into the determination.

When the test was first proposed, it was suggested that the temperature be raised at the rate of from 125 to 150° C. per hour, but it was soon found that this was too rapid, as the temperature of the air-bath in the oven in which the device was placed was found to run ahead of the temperature of the test-piece itself. The proper heat increment is 50° C. per hour, as at this rate the lag in temperature between the air-bath and the test-piece is not over 5 to 6° C.

The source of heat must be so chosen that the test-piece is heated uniformly along its entire length. If this precaution is not taken, serious discrepancies in the test will result.

## Multiple Tests

If several of the Martens test apparatus are built into a single heating chamber, thin partition walls between the devices should be inserted, so that when one of the pieces breaks during the test the other adjoining ones will not be interfered with. No standards have been adopted for the heating chambers, as it was thought best to make the test applicable with ordinary laboratory ovens, the only precaution being that the heating be as uniform as possible. Existing heating-ovens are entirely adequate for the purpose. In order to make it easy to adjust the slidable weight along the lever  $H$ , the latter should be graduated or have marks at certain points.

The Martens test is a rather severe one, as the strain upon the test-piece, even in the cold is quite pronounced. The great advantage of the test lies in the fact that the beginning of the distortion of the sample due to its heating is easily recognized. When test-pieces that have undergone the Martens test are examined, the distortion is sometimes hardly recognizable with the naked eye. According to the standard directions for



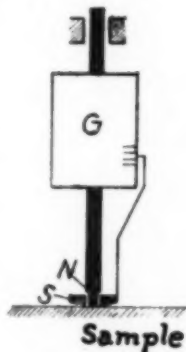
carrying out the test the temperature is determined at which the weight lever H, standardized at 240 millimeters in length, shows a deflection of 6 millimeters. If the test is to be even more severe, the beginning of the deflection of the lever may be noted, and readings may be taken from deflections of from 1 mm. to the 6 mm. limit, the results then being plotted on a curve, such as shown in Figure 4. In this figure the deflection is plotted as a function of the temperature. The numbers or types correspond to the designations given below.

Many years of experience have demonstrated the fact that the Martens test is very reliable. The apparatus used is not only simple, but can be made at very little cost, and it avoids all the sources of inaccuracy that arise in other tests by reason of frictional losses.

#### An Alternative Method

The numerical data obtained when subjecting a sample of molded insulating material to the Martens test may appear to be rather low. However, this is by no means a disadvantage. As many manufacturers, however, made objections, a second test has been adopted for the determination of the resistance of the insulating material to heat. This is a modified Vicat needle test (which is a device usually employed in testing the setting of cement).

The Vicat needle testing apparatus (as illustrated in figure 5) comprises a steel needle N having a carefully ground flat end that is exactly 1.13 mm. in diameter, and therefore has an area of 1 square millimeter. This needle is weighted down with a weight G equivalent, with the needle, to exactly 5 kilograms, so that a constant force

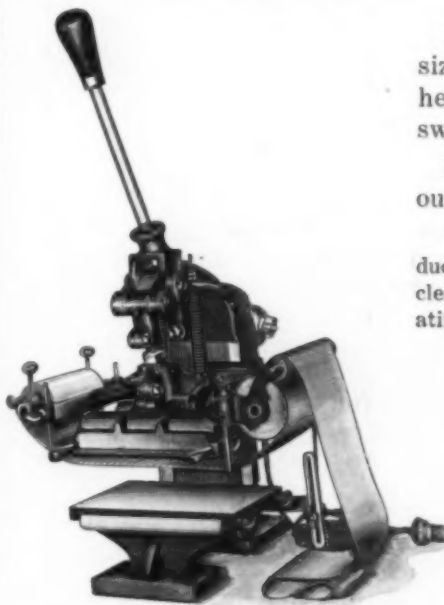


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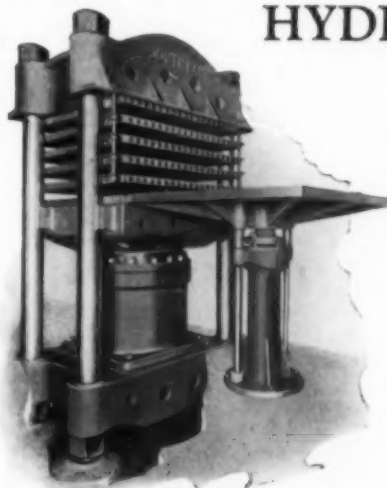
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(Continued on page 511)

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# TECHNICAL ABSTRACTS

## AND PATENT REVIEW

**Viscosity of Cellulose Nitrate Solutions.** O. Mertz, in *Farben Zeitung* (German), 1928, 31, 209.

A fifteen page discussion, in great detail, of the viscosity characteristics of cellulose nitrate solutions, especially from the view-point of the lacquer chemist. As a general rule the viscosity of the cellulose nitrate is a function of the size of the ultimate cellulose nitrate particles, although the nature of the solvent likewise has an effect. The viscosity of cellulose nitrate is lowered by depolymerization of the cellulose molecule either during nitration or by after treatment. The higher the molecular weight of the solvent, the higher is the viscosity. Small amounts of water in the solvents have a tendency to lower the viscosity, but a further increase of the moisture raises the viscosity.

**Apparatus for making cellulose acetate.** British Patent 274814, July 26, 1926. Societe Chimique des Usines du Rhone.

A rather complicated set of apparatus for the continuous acetation of cellulose.

**Molding Powder from Cellulose Acetate.** British Patent 275558, Aug. 3, 1926. Societe Chimique des Usines du Rhone.

The admixture of the cellulose acetate with the fillers, coloring matter etc., is accomplished while the acetate is dissolved in a solvent, preferably one that is miscible with water. Plasticizing agents as the paratoluenesulfonamide may also be added to the solution which is thereupon allowed to flow into water (or other non-solvent of the added ingredients and the acetate) to precipitate the mixture as a fairly uniform precipitate, which is dried at low temperature and powdered. The product is capable of direct molding in heated dies.

**Preparation of Cellulose Formate.** British Patent 275641, Jan. 11, 1926. E. Elöd.

The essential feature is the formylation of cellulose by means of substantially anhydrous formic acid in the presence of materials that exert an intumescent effect on cellulose, as for example zinc chloride. Further, catalysts such as phosphorus pentoxide or hydrochloric acid may also be used. A preliminary partial nitration of the cellulose may be carried out to secure better esterification.

**Glyptal.** H. Warren. In *Electrician*, 1927, 98, 286-7.

A short account of glyptal, the phthalic acid-glycerol resin, which the author calls a "new" resin. The article contains a short list of the

various synthetic resins and their makers.

**After-curing of phenoplastic resinoids.** British Patent 275011, July 12, 1926.

Relates to the after-curing of molded phenolic resin products, wherein they are heated for a prolonged period, say 4 to 6 hours at temperatures slightly above that of boiling water, not exceeding 135°C. The electrical insulating properties are said to be considerably enhanced thereby.

**Purifying Synthetic Resins.** British Patent 274581, April 26, 1926. A. Drummond.

Phenoplastic resins are improved and purified by treatment with the vapors of alcohol or similar solvent.

**Resinoids from aniline and formaldehyde.** British Patent 274501, July 16, 1926. P. Haller and H. Kappeler.

A condensation product of the anhydroformaldehydeaniline type is treated with methylamine, pyridine or similar organic amino compound, or with solutions of sodium sulfite, chloride, sulfate, etc.

**Plasticizing glycerol-phthalic acid resins.** British Patent 275219, Aug. 2, 1926. R. Kienle.

To overcome the brittleness of glycerol-phthalic acid resins there are added, during the manufacture of the resin, such plasticizing agents as dibutyl phthalate, triphenyl phosphate, triacetin aniline and many others, most of which have found application in the cellulose ester plastic art.

**Glycerol-phthalic acid resins.** British Patent 275604, Aug. 3, 1926. J. H. Schmidt.

During the condensation of the phthalic anhydride with the glycerol only solvents having a low boiling point are employed during the early stages of the condensation. Later high boiling solvents are added, evidently with the idea of having some of these solvents remain in the resin to enhance its pliability and flexibility. The products mentioned comprise diethyl oxalate, diethyl phthalate, dibutyl phthalate or the corresponding tartrates. Resins made from polyglycerols and other dibasic acids in place of the phthalic anhydride, i. e. such compounds as malic, succinic and maleic acids are suggested.

**Combined rubber and cellulose ester plastics.** British Patent 274968, April 30, 1926. P. Allman, H. Morris and L. Marlor.

The combination of rubber and the

cellulose esters is accomplished by the use of mutual solvents such as cyclohexanone, or tetrahydrodronaphthol, the latter remaining in the mixture and softening the same. The process is applicable to both the cellulose nitrate and acetate.

**Acetylizing Ethyl Cellulose.** British Patent 268552, April 10, 1926. Courtaulds, Ltd., W. Glover and C. Diamond.

Monoethyl cellulose is acetated with acetic anhydride, yielding a product of ethyl cellulose acetate. The particular ethyl cellulose is insoluble in water as well as in the ordinary organic solvents, and is not the usual pantaethyl cellulose.

**Cellulose Esters and Ethers.** British Patent 275,660, Aug. 8, 1927, (Convention date, Aug. 6, 1926). Inter-sen-gemeinschaft Farbenindustrie. (German Dye Trust).

Relates mainly to cellulose carboxylates and xanthates. For example cellulose pulp in sheets is steeped in a 70% caustic soda solution in a vacuum, squeezed out and subjected in an autoclave at 100°C and 5 atmospheres pressure to ethyl chloride vapors to produce an ethyl cellulose. Use of carbon disulfide to form a xanthate is also described. Cellulose laurate is made in the same way using lauric acid chloride in vapor form.

**1:4 Dioxane as Cellulose Ester Solvent.** British patent 275,653; Dec. 23, 1924 (conv. date). I-G. Farbenindustrie (German Dye Trust). 1:4 dioxane is used as a cellulose acetate solvent. May be used to combine resins and cellulose esters in one solution.

**Cellulose Ethers.** British Patent 277,111, June 10, 1926. I. G. Farbenindustrie.

In order to increase the solubility of cellulose ethers, they are depolymerized with acids as hydrochloric, oxalic, etc., or a mixture of zinc chloride and hydrochloric acid. The action may take place in a liquid such as a mixture of alcohol and benzene, wherein the ether eventually dissolves, being later precipitated by water and washed. Treatment of ethyl cellulose with glacial acetic acid and sulfuric acid is described.

**Molding Pyroxylin Plastic Scrap.** British Patent 277,626, Sept. 18, 1926 (convention date). Rheinische Gummi und Celluloid Fabrik, Mannheim, Germany.

Pyroxylin plastic waste is finely divided and mixed with from 2% upwards of a cellulose nitrate plasticizer such as triphenyl phosphate, acetanilid or the like and molded under heat and pressure.

**Cellulose Ethers.** British Patent 277,721; March 26, 1926. Henry Dreyfus.

In producing cellulose ethers according to Brit. pat. 166,767 wherein cellulose is treated with a halogen compound of glycol or other polyhydric alcohol, according to the present invention the water formed in the reaction is taken up by a material capable of combining therewith, such as alkali oxides, calcium hydride, soda-mide and sodium ethylate powder. For example cellulose is mixed with water and sodium hydroxide plus calcium oxide, the mixture being kneaded, while cooled. Ethylene oxide or ethylene chlorhydrin is then added at 0°C, forming a cellulose ether.

**Fibrous strong molded resinoid plastics.** British Patent 278,038, May 26, 1926. Jaroslaw's Erste Glimmerwaren-fabrik.

Fibers in sheet form such as paper, fabrics, etc., are coated or impregnated with a synthetic resin, the fibers then being separated by mechanical means during or after drying. The fibers are kept intact as far as possible. The fluffy mass is molded under heat and pressure as usual. For example paper web having 35% of a synthetic resin is opened in a beating engine, 15% powdered resin is added and the mass is molded.

**Alcohol and ketone urea condensation products.** British patent 278,390, Oct. 4, 1926 (convention date). I. G. Farbenindustrie.

Oily or resinous condensation products are obtained by the prolonged heating of a urea or derivative with excess of an alcohol or a ketone in presence of a catalyst. Pressure may be used. The initial product is a urethane which further condenses with the alcohol. The products are cellulose ester plasticizers. Examples are urea+benzyl alcohol or butylene glycol, using glycerol as catalyst; urea+ethyl alcohol, acetophenone or cyclic acetal. Others are acetyl urea+diacetin; thiourea and butylene glycol and urethane+glycerol.

**Cellulose Acetate Plastics.** British Patent 278,735; April 24, 1925 (convention date). (addition to 251303).

Cellulose acetate is dissolved in the acetate of ethylene glycol mono-methyl ether. Benzene or ethyl alcohol and plasticizers are added. Provisional specifications mentions use of the formate, acetate or phthalate of the ethylene glycol methyl or ethyl ethers, methyl phthalate or phenyl phosphates.

**Aminoplastics.** British patent 278,698; Oct. 8, 1926 (convention date) additions to 258,289. I. G. Farbenindustrie.

Urea is condensed with formaldehyde in the presence of primary sodium phosphate; after the addition of a mixture of secondary and tertiary sodium phosphate to reduce the hydrogen ion concentration to a ptt of 6-7, the solution is partially concentrated in a vacuum; formaldehyde is then added and after the con-

(Continued on page 510)

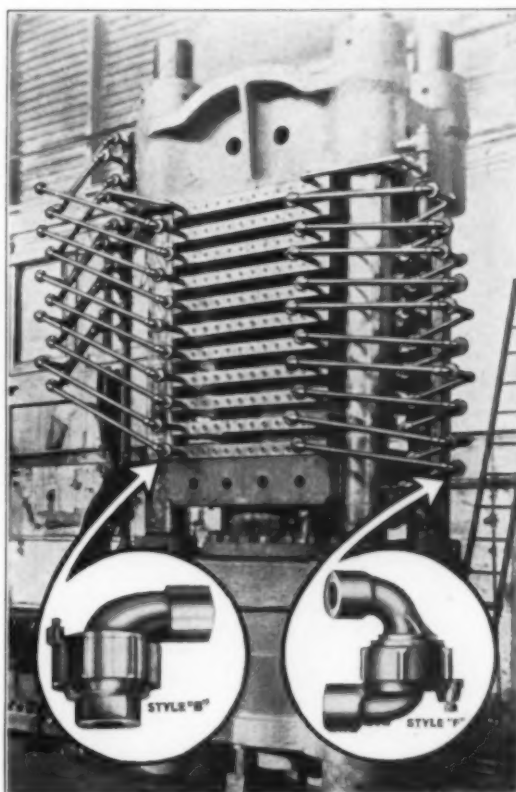
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## Essential Books

### Plastics and Molded Electrical Insulation.

Emile Hemming. 313 pages. Illustrated. \$6.00.

Very special care has been taken in the preparation of the chapter on molded insulation. Contains hundreds of references to plastic and composition products and their utilization in industry.

### Casein and Its Industrial Applications.

Edwin Sutermeister. 296 pp. Price \$5.00. Illustrated. 1927.

Eleven authorities, many of them specialists in this field, have contributed to this volume. "Casein Plastics" is from the pen of Dr. Geo. H. Brother.

### The Chemistry of the Natural and Synthetic Resins.

T. Hedley Barry, Alan A. Drummond and R. S. Morrell. 196 pp. Price \$5.50. 1926.

The work of three English chemists, who are recognized authorities on this subject, one of vital interest to the Plastics Industries.

### Celluloid.

Its raw material, manufacture, properties and uses. Dr. Fr. Bockmann. 188 pages. 69 illustrations. \$3.50.

In this book, the raw product, cellulose and its properties are thoroughly described. Other raw materials and methods of rendering them more plastic also receive attention.

### Synthetic Resins and their Plastics.

Carleton Ellis. 514 pages, illustrated. \$8.00.

The book will serve as a guide and prove a stimulus to the numerous investigators and practitioners in the field of artificial resins. The section on plastic molding is an especially valuable feature.

### Pyroxylin Enamels and Lacquers.

Samuel P. Wilson. 213 pages. Illustrated. \$3.50.

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centration has proceeded further, the viscous product is hardened in a mold by prolonged heat treatment. A second example mentions the use of a buffer mixture of sodium acetate and acetic acid.

### Molding Phenoplastics.

British Patent 276,440, and 276,441; May 28, 1926. Products Protection Corporation. Discloses a process of molding phenoplastics containing wood flour, in which the resin is preliminarily heated to nearly the stage where conversion to the B-state takes place. Molding is effected between 100 and 130°C. The material is subsequently tempered or annealed by slow cooling.

The second patent relates to curing phenoplastic compositions while immersed in molten cumarone resins or chlorinated naphthalenes, products which do not dissolve or otherwise interfere with the curing of the resin. Hydraulic pressure can thus be applied to the object directly without the intervention of a mold. The apparatus is fluid tight, and internally heated electrically.

### Molding Phenoplastics.

British Patent 275,678; Feb. 10, 1926. H. Burmeister. Fairly rapid curing compositions are obtained by condensing a solid formaldehyde derivative or polymerization product with a dihydroxybenzene such as resorcinol, with the addition of glycerol to control the speed of the condensation.

### Aminoplastic.

British Patent 275,995; Aug. 11, 1926. Societe anonyme pour l'Industrie chimique a Bale, Switzerland. Comprises reaction and condensation products of formaldehyde with either thiourea or a mixture of the same with urea. The ratio of the materials is smaller than 1:2.

### Beading Fabrics with Aminoplastics.

British Patent 277,091, June 8, 1926. British Bead Printers, J. Vredenburg and F. Heynert.

Bead like ornaments are applied to fabrics, much in the same manner as Bakelite beads have been applied, in a sort of polka dot effect, only in this case using the urea-formaldehyde condensation products. Materials to enhance the effect, such as pulverized glass, bronze powder, etc., may be added.

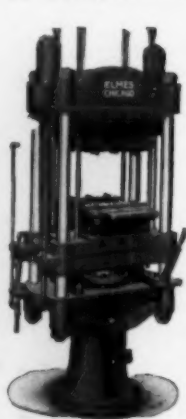
### Indurating Casein.

British Patent 276,542; Dec. 1, 1926. Societe Industrielle des Matieres plastiques.

The hardening of casein solids is accomplished by compressing casein that has been moistened with formaldehyde or with a compound capable of giving off the same, as for example the bisulfite compound of formaldehyde. (Cf. the Byron B. Goldsmith patents reviewed in the August issue of PLASTICS).

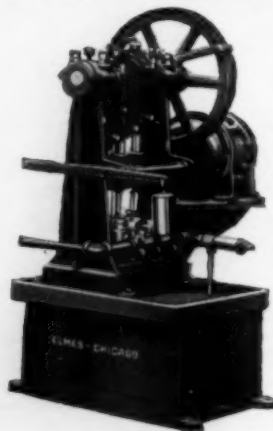
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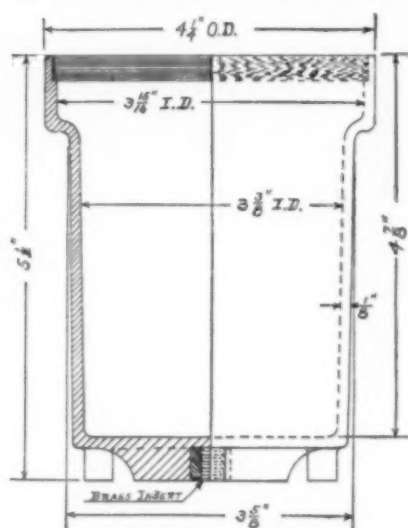
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See October

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### Martens Test

(Continued from page 507)

of 5 kilograms per square millimeter may be exerted against the material to be tested. The rod upon which the needle and weight is mounted serves to guide the same vertically. A perforated piece of metal S through which the needle N passes, rests upon the sample. The penetration of the needle is recognized by its movement relative to the piece S, and this movement is examined under a magnification of at least ten times. The entire apparatus, as in the case of the Martens test, is placed in a heating oven and the temperature is raised at the same rate as in that test, i. e.  $50^{\circ}\text{C}$ . per hour.

The data is expressed in Vicat degrees, which is the temperature at which the needle N has penetrated 1 millimeter into the test-sample. Using the identical material in the Martens and Vicat test, the latter will invariably give higher numerical readings.

As compared with the testing methods adopted in other countries, it can be stated that the

Martens test has practically no possible points of error.

The designation of the different kinds of insulating material at present recognized in Germany is as follows:

The association of manufacturers of electrical insulation (in Germany) has been active for years in working up standard specifications for the various types of insulating materials.

Table 1

Type	Composition	Molding Process
S+0.	Resinoid, wood our or cellulose.....	Hot molding
1.	Resinoid, asbestos .....	Hot molding
2.	Resinoid, asbestos, mineral fillers .....	Cold molding
3.	Resinoid, mineral fillers .....	Cold molding
4.	Asphalt, asbestos, mineral fillers .....	Cold molding
7.	Natural resin and asphalt, asbestos, and mineral fillers .....	Hot molding
8.	Asphalt, asbestos or cotton flock, mineral fillers .....	Hot molding
10.	Cement or sodium silicate, asbestos, mineral fillers.....	Cold molding

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**New York City**

The heat test on the German standard types of molded insulation, as given in Table 1, is as follows:

Type	Martens Degrees, minimum
8	150° C.
0	125
1	150
2	150
3	150
4	150
7	65
8	45
10	150

**Goldsmith**

*(Continued from page 499)*

which the usually kneading and mixing and rolling are applied to produce sheets of a thermoplastic material.

Every possible ramification of the original process was investigated by Goldsmith, although the same fundamental idea runs through all of his patents. Another one, although filed on the same day as the earlier ones (Oct. 7, 1907) did not issue until Oct. 21, 1913 as No. 1,076,417. In this one the use of a preliminarily indurated gelatoid compound, followed by the treatment with the converting agent, is described.

**With Keratin**

The use of formaldehyde with keratin was the subject of still another of Goldsmith's patents, No. 1,114,981, of Oct. 27, 1914. Powdered keratin is mixed with a converting agent of the kind already described, and is then sprinkled with a solution of the indurating agent, such as formaldehyde, then drying and subjecting the material to heat and pressure in a mold.

The last patent of this particular type of product, but still relating back to his application of October 7, 1907, is patent No. 1,134,527; April 6, 1915. This does not differ much from those already described, but applies the process specifically to egg albumen, the converting agents and formaldehyde solution.





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His last patent in this field is quite different. Filed on Aug. 3, 1912, it matured into a patent 1,152,625 on Sept. 7, 1915 and related to a composition that could be used as a coating material, just like his first patent of 1898 did. In this case however, Goldsmith was working with the cellulose esters, having found an apparently useful softening or dissolving agent for both cellulose nitrate as well as acetate in superficially nitrated oils. Goldsmith however says that what he really does to the oil is to oxidize it. For example 200 cubic centimeters of an oil such as soy bean oil, cotton seed oil, olive oil or the like is heated on the water bath with 100 cc. of water from 60 to 100 cc. of con-

centrated nitric acid. Nitrogen oxide fumes are evolved and the reaction proceeds with considerable foaming. When it has quieted down the oil is separated from the acid and thoroughly washed until neutralized. It will then, so says the inventor, have the property of readily mixing with cellulose esters or their solutions.

One compound proposed consisted of cellulose acetate, phenol and the oxidized oil.

From the foregoing it is quite evident that the general knowledge as regards the casein thermoplastic masses was considerably advanced by the work of this investigator.

*It is our intention, if our readers show their interest by so advising us, to review from*

*time to time, in condensed form, the achievements of specific workers in the field of the plastic materials. It is a distinct advantage to the man engaged in working out new problems to know what has been done in the past. While the general subject of "plastics" is entirely too great to permit a full review of this highly ramified art, we hope, as the only journal of its kind printed in English, to make it a clearing house of general information, both as to what is occurring daily, but to bring the knowledge of the past in readily available form to our readers, so that eventually there will be built up a bibliography of plastic materials that will find, we trust, a permanent place on the library shelves of our contemporaries.*

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## Recent Resin Art

(Continued from page 503)

separated and derived from the drying oils such as linseed oil, although some of the examples given include rosin and China wood oil fatty acids. The condensation is effected in the absence of air by passing carbon dioxide through the vessel in which the mixed materials are heated. 7 to 10 hours at 180-265°C serves to effect the formation of the desired resin, which may be made from  $\frac{3}{4}$  mols of pentaerythrite, 1 mol phthalic anhydride and 1 mol linseed oil fatty acids. Other organic acids such as succinic, malic, maleic, fumaric, tartaric, citric and the like many replace the phthalic anhydride, and other natural resins as Copal may be incorporated with the mixture. The products are soluble in the available commercial lacquer solvents.

*The contributions of the Barrett Co., flexible resins and many other ramifications in this field will be described in a continuation of this article in the October issue.*

## Molded Mica

A review of this little known but important art, by Joseph Rossman, who recently reviewed the production of fiber gears, will begin in the October number.

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# MOLDED PRODUCTS

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Vol. 2

SEPTEMBER, 1928

No. 9

## Breaking Traditions

Progressive Molders seek new fields to conquer—some instances of success

By H. S. Spencer

Advertising Manager, General Plastics, Inc.

THE breaking down of traditions or customs is one of the hardest jobs that molders of phenolic compounds have been confronted with and possibly therefore their general hesitancy to do so.

The manufacturer using wood, metal or rubber is equipped by experience, men and machinery to use wood, metal or rubber. Why should he become excited over a stranger's proposal to use a new material unknown and untried in his field? The answer to his "why" must be determined before he can be convinced.

Coming into a field already existent, but in which the opportunities were unlimited, and even today where the surface of these possibilities have been only scratched, General Plastics determined that its development or sales promotion program should include as much pioneer work as the tariff would bear. That is, that in appropriating money for sales and advertising, so much must be definitely set aside for the education of industry outside of the fields, at that time largely radio, automotive and electrical. This latter was making great strides and it was apparent that its many possibilities for phenolic molding compound would soon put it in first place.

Today it continues to offer new opportunities for molded applications. The automobile manufacturers are buying many molded parts. This also offered great opportunities. Activity beyond these three industries was scattered and in many, but very little definite plan existed, nor was much done to open up these new fields.

As advertising Manager of General Plastics, it devolved on me to work out some definite plan of procedure, insofar as the market for Durez was to be increased, for I concurred in the policy of my employers to look ahead, and to work toward the future on a practical pay-as-you-go plan. That is, to tackle things which it was most reasonable to expect would result in definite returns and a continuous market.

### New Opportunities

The tabulation of possible molding opportunities put furniture as a practical possibility and as a large market, type-writer frames as another, telephone parts (this was two and a half years ago) as still another. We also listed a wider application of our material among automotive manufacturers—big outlets but necessarily slow to develop. We put them on the

active list for decided and continuous effort. After concentrating on what we believed would be practical applications where definite plans would result in immediate business, we listed clocks, door knobs, collapsible container tube caps, ink wells and about forty other applications, mostly industrial, as a means of securing immediate business for ourselves and customers.

In each case we made a careful study of the business we contemplated entering. If the preliminary investigation looked right, we proceeded. If not, we dropped it.

Space does not permit details but for the possible guidance of others contemplating similar efforts, it may be well to review briefly several of these applications.

A good household thermometer, either for desk, table or wall, looked practical. It offered an opportunity to mold a standard piece for either desk or wall type with a separate pedestal. There seemed to be no unusually attractive product of this kind on the market at anywhere near a reasonable price. Those existing were very cheap or very expensive. We found several large manufacturers were interested, but when it came into the prac-



tical part of the work, their Sales Department complained because they contended that pieces could not be sold at the price necessary to get a profit.



Non-corrosive molded terminals opened a new molding field.

Trade traditions proved too tough and we dropped the matter quickly.

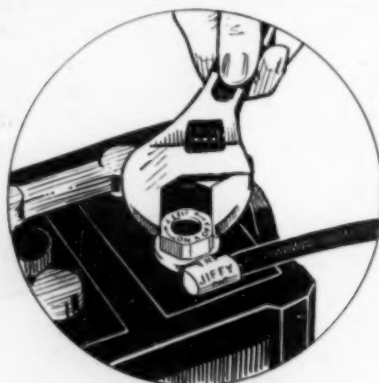
Collapsible tubes—our preliminary step was to visit a number of druggists in different parts of the country and ask if complaints were ever made on tooth paste containers. We found that they were and one large manufacturer had recently taken back a number of shipments because of air leakage, due to drying of the paste through a poor fitting cap. We found the reaction of metal caused blackening of the paste, making it obnoxious looking; that the threads were frequently stripped leaving caps loose; that we could eliminate the need for the specially prepared waterproofed cork inserts. This was all encouraging.

#### The Potential Market

A little research showed that the cost of tin and antimony was high and going higher. Along with this information we secured a list of all the tooth paste and shaving cream manufacturers and secured figures of the potential market. It was very much worth while to go after and the time was right.

Three of the largest users were selected for personal attention and the balance for mail work. Out of the list of 121, six wrote in immediately for samples and quotations.

E. R. Squibb & Son ordered a trial quantity of caps and appropriated money for investigation and research. They proceeded with great care and deliberation, for their reputation is an enviable one of conservatism and only the best of products. Their laboratory and research department made exhaustive tests lasting over many



months, final test of which was to put molded Durez caps on a number of tubes and store them in a vault for six months. Every test worked out satisfactorily. In the meantime we worked with their Advertising Department, Sales Department, Research, Production and Purchasing Departments and the company officials, that all might know and understand the advantages of molding and place their O. K. on molded caps when the time might come.

At last the caps were on the market. Squibb extended the use to their shaving cream and other products. Others followed Squibb and our entire industry benefits today and will continue to do so on a larger scale as the use of molded caps is extended to additional manufacturers. It has already crossed the border into Canada.

The same story as that just related—could be told of every industry where custom and traditions have been disturbed. The resistance is naturally strong, but if you can prove profitable advantages to the

manufacturer, he will listen. If you are right and work hard, you can sell him.

We found that clock manufacturers were in a highly competitive industry. The situation showed that the Ansonia Square Alarms were successful. That Westclox Big Bens were sold in sufficient quantities to be worthy of Saturday Evening Post advertising. We could see no reason therefore why Durez should not make a very attractive timepiece, offering many advantages, such as a wide range of permanent colors. Colors were rapidly coming into the home for every conceivable article; also that the range of designs were unlimited.

The New Haven Clock Company recognized the possibilities offered by Durez and brought out the Art Alarms, starting with one small model and over a short period of time, as each number proved successful, increasing the line until nineteen different models are on the market today, retailing from \$1.29 to the handsome eight-day clock retailing at \$25.00. Other manufacturers followed, and molded clock frames are now a permanent factor in the molding industry.

#### Another Molding Conquest

One more experience in what we have classed as the industrial field, that is, purely industrial pieces. Battery terminals and nuts have been made of metal. These metal pieces corrode and are therefore objectionable. We knew that phenolic compounds would overcome this. Here then was an opportunity. Investigation of the battery field revealed that our nearest city—Buffalo—had such a manufacturer. Incidentally, his superior terminal when combined with phenolic compounds eliminating corrosion would make the product about 100%. Undoubtedly, this manufacturer was our man, and Jiffy terminals the application. Extra strong Durez material #70 was supplied, special type of metal insert devised and Jiffy terminals became a better product and are

enthusiastically accepted by the largest users in the world.

It is commonly said that advertising is the means of making business successes. While we do not deny this, it is nevertheless true that an improved product is likewise a tremendous factor.

Investigation and research are essentially a part of sales promotion, if it is to be rightly done. Rightly done, it is profitable. Let us analyze this. In the promotion of Durez who profits? Naturally ourselves, General Plastics. Then the manufacturer of the more saleable product through his increased sales. Likewise the custom molder doing the work, to whom we have turned over this additional business. Beyond this, the other manufacturers in the same line of industry who take up the idea, as they invariably do.

Just as they are benefitted the manufacturers of competitive molding compounds also profit by the development for as the application broadens out, it naturally includes them. They benefit by our effort and we in turn, of course, by theirs, so we may say that finally the entire industry is benefitted by the original effort of one organization.

Now we can go on and analyze this further. The manufacturer making the improved product advertises it. This attracts other manufacturers in other lines to molded parts, as does the increased sale of these improved products increase. In turn the distribution of molded parts carries it on to jobbers, dealers and distributors, and finally to the man on the street.

In addition to this advertising, there is, of course, the advertising of individual molders and that of General Plastics which is planned to attract those in other fields. This of course aims to develop new fields where research and salesmanship must be prepared to follow through and overcome the trade traditions. Thus, the chain becomes endless and the market continues to broaden indefinitely.

## Pyroxylin Flowers

**T**HE demands of interior decoration are perhaps greater and harder to satisfy this year than ever before. Beauty and color must be brought into the home; also they must be of a lasting and practical nature.

Take artificial flowers, for example. They are no longer the simple, unattractive cloth or paper imitations of a few years ago, but are intricate works of art. The Louis S. Bach Company of Chicago has created one of the newest types of dainty, varicolored artificial flowers from Pyralin sheeting. The wide variety of floral colors and the strength and beauty of this material make it ideal for the purpose.

In making the flowers patterns cut from flat sheets of Pyralin are formed into petals and leaves, and are then assembled to represent various species. Roses, orchids, poppies, asters, even sprays of dainty anemones, all as fresh and beautiful as Nature's own first buds in spring, are a few of the more popular ones. Rain, frost or sun will not mar their beauty, because of the durability of Pyralin.

A few of these flowers are shown in the accompanying illustration, but the black and white reproduction gives only a faint idea of their true beauty and loveliness. It is difficult, (Please turn to page 533)





# Exploiting the Toothbrush

New styles and combinations offer a fertile field for molding—An assured market for novelties

By Nicholas Klein Ch. E.

**A**SSUREDLY, no one doubts the fact that the toothbrush is a staple article in the plastic industry. To the naked and untrained eye, a glance at the toothbrush counter in a department store or chain drug store presents a bewildering aspect. A maze of size, shape, color, choice of material, style of bristle, type of container, and tricky innovation in one of these features or another tends to make so simple a task as the selection of a toothbrush quite a problem to the prospective purchaser. This situation is partly the result of the wide diversity of opinion among dental authorities as to what constitutes a satisfactory toothbrush. The fact that the demand for such a wide range of variations has been met by the plastic industry is a tribute to the art.

In its essentials, a toothbrush consists merely of hog bristles set in a handle. In our modern civilization, the toothbrush is elevated beyond such bareness. In the matter of color, for example, which is commanding the attention of the entire plastic industry, an important consideration enters. Just as white-tiled restaurants have given way to oak-paneled tearooms, so have amber, red and green toothbrushes been accepted as equally hygienic as the more classic white. Aside from the solid colors, in both the clear and transparent, a very popular finish is the pearl effect in the softer pastel shades which produces quite a luxuriant appearance. These are generally made of laminated stock, with strips of the pearl-finish sheet on both sides of the heavier stock, generally transparent.

Unlike so many plastic products, in which color has been

introduced as a merchandising appeal, colored toothbrushes have a utilitarian value. The bathroom toothbrush rack holding half a dozen white toothbrushes would entail nerve-racking handling on the part of the several members of the family in finding their respective brushes. So, in the matter of

identification, color becomes an actual necessity in toothbrushes.

An ideal toothbrush is one whose bristles can be brought in contact with the maximum dental surface. This is achieved in several ways. The head of the brush may be bent at a slightly acute angle to the handle as in the manner of the 'Prophylactic' brush or at an obtuse angle in the style popularized by Dr. West, to facilitate brushing of the inner surface of the teeth. The small-headed brush with two rows of bristles of seven knots each seems to be filling this requirement. Trimming of the bristles in chisel fashion or in the so-called "tufted" style goes towards making a toothbrush that will reach inter-dental spaces.

## Toothbrush Novelties

An interesting and attractive handle, both to the molder and the user, is the "TEK" brush. This toothbrush is made to accommodate a spindle of dental floss in the handle as a daily reminder of this useful aid in keeping teeth clean. The handle being of transparent, amber, pyroxylin, fitted with a metal screw cap, keeps the floss moisture proof. In spite of its obvious bulkiness, the handle is well balanced and has a comfortable "feel."

A novel toothbrush that has been engaging the attention of car card readers is the "TEFRA", the salient feature of which is the replaceable head. From the molders point of view, a new problem is presented in that the handle is a distinct departure from the conventional solid type. The thin-walled receptacle for the bristle head must be sufficiently elastic to permit removal of the head and



A toothbrush provided with a dental floss container in the handle.





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at the same time possess enough tension to prevent slipping out, especially while the brush is in use. The slot in the throat is a feature of the design which is an aid in this respect. The "refillable" idea was introduced by "Tefra" in order to promote the notion of a hygienic toothbrush. Dental experts maintain that the wholesome life of a toothbrush is three months. Low-priced refills of this sort, which eliminate such frequent discarding of an entire brush, makes towards an attractive appeal to the purchaser—who is mindful of his teeth. A rubber refill is also made to fit the handle as an aid in developing healthy gum tissue.

Another brush of the removable head type is one with a metal clip that snaps into a metallic staple imbedded in a

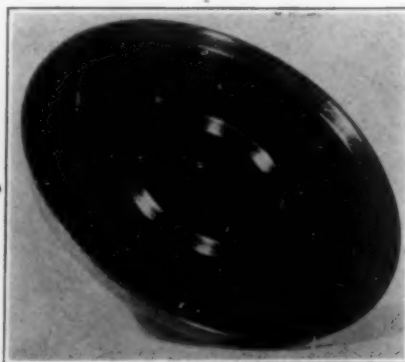
handle made of some plastic material. The head may be swung around at any angle to facilitate reaching every bit of dental surface.

Among those toothbrushes that still require further development or exploitation is one that carries its own dental cream in the handle. A screw plunger forces sufficient paste on to the bristles to make the toothbrush ready for use, thus eliminating the operations involved in transferring toothpaste from the tube to the brush. Other such novel treatments of the staple toothbrush constantly command the attention of the plastics molder or promoter, an indication that in spite of the apparent flooding of the field, saturation has not yet been reached.

## Molded Hot-Plate Tray

**T**HE modern housewife need no longer sacrifice beauty to utility at the dinner table. A new Durez product, a hot-plate tray, has come to lay the ghost of the unattractive metal utensil used for the same purpose. This new tray can be made in all colors, and decorated, as the one here shown, with metal inlays of any design. The property of heat insulation, and the durability of this molding material assure high efficiency as well as the utmost in daintiness. It is an encouraging instance of

the inroads molders are making into the little exploited field of table utensils.



An attractively decorated hot-plate tray molded of Durez.

## Sheet-Plastics In Foot Corrective Appliance.

**T**HE Wizard Company of St. Louis, Missouri, for a number of years has been engaged in the manufacture of Wizard Arch Builders and similar corrective foot appliances. Metatarsal and other foot troubles of many types have been success-



The arrow shows the Trimfoot appliance fitted into the shoe

fully corrected by the use of these devices.

Today, in the average woman's shoe, there is little room for corrective adjustments of the conventional type. Trimfoot is a new product especially designed to meet this condition. It fits modern footwear so that it may be made a part of the daintiest shoe without the wearer being conscious of it except for the comfort it gives.

The manufacturer took as his starting point the requirement that the article must be so thin that its presence would not be noticed even in the smartest shoe. The finished result is a product having all the adjustable features of a conventional foot-corrective appliance and occupying only a small space in the shoe.

Trimfoot consists of two thin strips of leather between which is placed the Pyralin carrier fitted with the rubber inserts that build up the arch of the foot. This relieves the pressure which might cause callouses, and corrects other painful conditions in the forward part of the foot.

In reality, this is the modern method of individualizing each shoe and fitting it properly so that painful foot troubles, which cause nervous strain and the gradual breaking down of nor-

(Please turn to page 533)

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# Domestic and World Trade In Plastics

Government survey shows promising outlook for Plastics industry  
—Production increase should continue and world markets grow

By J. N. Taylor

Chemical Division Bureau of Commerce

THE increasing application of plastics in industry and their utilization in everyday life explain their advance to a position of importance in world commerce. Particularly commanding is the position of the pyroxylin, a branch of the plastics industry which in late years has been revolutionized by the growth in the use of lacquers as paint materials for furniture and inside work as well as by automobile manufacturers.

foreign trade is by far in materials manufactured from pyroxylin. Under trade names such as celluloid, pyralin, viscoloid, fiberloid, and xylonite, they are well known to the public through their many applications in the manufacture of toilet-ware, automobile curtains, and various other articles. Even furniture to-day is made from plastics. In 1925, according to the Bureau of the Census, the total production of pyroxylin

artificial resins, occupy a secondary position, the combined production of these two classes in 1925 amounting to only \$9,870,000.

## The Pyroxylin Industry

The many uses for the lower nitrated cellulose products, the pyroxylin, have given rise to an important industry. Collodion, a solution of pyroxylin in ether and alcohol, has a restricted employment in surgery and is largely used in the manufacture of photographic films and plates, making possible modern photography with all of its remarkable applications. Because of their diminished inflammability, the cellulose acetates are taking the place of the nitrates in the manufacture of motion-picture films. Collodions are used also for lacquers, in the waterproofing of cloths and in the manufacture of artificial leather for use in making belts, bags, shoes, in book binding, and in the manufacture of automobile upholstery and other artificial fabrics. Nitrated cellulose is the basis of one of the early French processes for the production of artificial silk.

The domestic production of all pyroxylin products—exclusive of collodion—practically doubled in the period from 1921 to 1925, inclusive. In the latter year there were produced for sale \$28,000,000 worth of pyroxylin plastics and pyroxylin solutions, not including production by paint and varnish factories. Values were about evenly dis-

Table 1

United States exports of manufactures of pyroxylin plastics

Country of destination	1926		1927	
	Quantity Pounds	Value	Quantity Pounds	Value
Belgium .....	12,483	\$10,168	3,225	\$3,537
France .....	13,711	3,643	2,710	2,748
Germany .....	13,501	1,342	1,362	4,010
United Kingdom .....	1,207,567	1,128,965	520,810	425,047
Canada .....	724,235	690,218	324,659	481,742
Guatemala .....	746	2,862	3,261	10,532
Panama .....	1,167	2,341	5,428	8,888
Mexico .....	17,211	30,638	28,547	55,525
Cuba .....	19,304	33,522	24,102	25,297
Argentina .....	7,895	11,743	4,625	7,383
Brazil .....	1,374	3,136	842	1,483
Colombia .....	1,814	3,762	2,282	6,494
Peru .....	1,785	3,720	785	2,243
China .....	621	1,014	699	2,423
Japan .....	6,761	3,860	651	777
Philippine Islands .....	3,592	5,383	1,771	2,395
Australia .....	125,769	119,259	94,951	96,714
New Zealand .....	3,095	4,181	3,338	5,275
British South Africa .....	15,858	2,707	2,516	6,305
Other countries .....	12,673	22,890	12,158	25,988
Total .....	2,191,162	2,085,354	1,038,722	1,174,806

The field of plastics embraces a number of commodities, in themselves not considered plastics, but which, however, are products of the industry taken as a whole.

## Bulk of Production and Trade in Materials Manufactured from Pyroxylin

Of those materials undoubtedly qualified to be designated as plastics, the bulk of our domestic production as well as of our

materials exclusive of amounts made and consumed in establishments reporting, amounted to \$75,987,000, of which \$48,732,000 worth constituted pyroxylin plastic solids and \$27,255,000 worth pyroxylin lacquers, enamels, thinners, and solutions. These figures, when compared with a total of around \$12,000,000 in 1914, reflect the growth of the industry in a little over a decade. Other plastic materials, such as casein plastics and

tributed between these two classes of pyroxylin products. The production of finished articles of pyroxylin increased in value from \$2,000,000 in 1921 to \$11,000,000 in 1925.

### Have Extremely Wide Application

As previously mentioned, pyroxylin plastics are properly known under a variety of trade names. They are made by incorporating camphor with pyroxylin dissolved in a suitable solvent together with a stabilizer, usually urea or one of its derivatives. Other chemical compounds, such as the salts of lactic, butyric, benzoic and camphoric acids, have been suggested for this purpose. Plasticizers other than camphor, such as borneol, acetanilid, naphthalene and phenyl naphthalene, have proved useful, and esters, such as triphenyl phosphate, tricresyl phosphate and trinaphthyl phosphate, are also employed as camphor substitutes.

In the process of manufacture, the nitrocellulose or pyroxylin is worked with camphor or some other plasticiser, a stabilizer and the solvent, and the resulting mass rolled into sheets. These are then compressed into blocks or other shapes. Colored products are obtained through the incorporation of a pigment or a dye.

Many articles in common use are made from pyroxylin plastics, such as toilet sets; handles for knives, umbrellas, and brushes; collars and cuffs, beads, bracelets, billiard balls, toys, tooth brushes, rulers, fountain pens, false teeth, mosaic flooring—in fact, their application is as wide as human needs demand. Their solubility in numerous solvents make solutions of pyroxylin plastics valuable as varnishes and lacquers for automobiles and furniture.

**Table 2**  
*United States exports of pyroxylin products known as celluloid, pyralin, viscoloid, fiberloid, etc., in sheets, rods, or tubes*

Country of destination	1926		1927	
	Quantity Pounds	Value	Quantity Pounds	Value
Belgium .....	58,945	\$48,582	85,496	\$99,837
Germany .....	7,447	5,858	32,604	6,280
Italy .....	4,454	4,084	6,652	6,974
United Kingdom .....	649,150	455,203	479,900	424,480
Canada .....	1,398,602	1,043,447	825,306	677,107
Mexico .....	5,558	5,600	5,866	5,902
Cuba .....	5,163	4,809	7,999	7,801
China .....	1,871	1,890	1,284	1,178
Japan .....	23,831	7,913	24,911	20,228
Philippine Islands .....	1,539	1,627	1,702	1,728
Australia .....	138,545	111,006	48,812	40,672
Other countries .....	28,338	21,529	9,370	10,427
Total .....	2,323,443	1,711,548	1,529,902	1,302,614

### Imports of Pyroxylin Products

Imports for consumption of pyroxylin products, known as celluloid, pyralin, viscoloid, fiberloid, xylonite, or otherwise (except hard fiber), increased progressively during the years 1924, 1925, and 1926, but dropped in 1927. The total values of all products, including all forms—finished and unfinished—amounted for each of these years, respectively, to \$1,557,417, \$1,758,866, \$2,824,460, and \$2,697,215. The bulk of the import was of finished or partly finished articles. Japan supplied the major portion.

### Shipments to Foreign Countries

Exports of pyroxylin plastics not made into finished or partly finished articles, in the form of sheets, rods, or tubes, decreased in 1927 as compared with 1926, as did also exports of manufactured articles. The quantity and value of outbound shipments of all products have decreased, nevertheless, the average price per pound of both classes of products has increased. Although exports to Canada have dropped considerably, that country continues to be the best customer, followed by the United Kingdom and Belgium. Australia's imports of American raw pyroxylin plastics decreased considerably while the value of shipments to Japan increased. Shipments to British India

dropped from \$4,000 worth in 1926 to a tenth as much in 1927, and to New Zealand from \$2,500 in 1926 to a third of this amount in 1927.

### Exports of the Celluloid, Pyralin and Allied Group

Table 1 shows the exports of pyroxylin products known as celluloid, pyralin, viscoloid, fiberloid, etc., in sheets, rods, or tubes.

### Shipments of Manufactured Pyroxylin Plastics

As in the case of unfinished materials, Canada is also our largest consumer of manufactured pyroxylin plastics and the United Kingdom comes second, although both of these countries took much less in 1927 than in the preceding year. The values of shipments to Belgium, France, Cuba, Argentina, Brazil, Peru, Japan, and the Philippines also declined but trade with Mexico, Colombia, China, New Zealand, and British South Africa increased in value.

The exports of manufactures of pyroxylin plastics from the United States in 1926 and 1927 are compared in Table 2.

During the first five months of 1928, Belgium's purchases of pyroxylin plastics were negligible, shipments amounting to only 46 pounds of unfinished material, valued at \$35. Canada continued to be the leading consumer of unfinished articles from the United States, while the United Kingdom was first as an importer of our manufactured pyroxylin plastics. During this 5-month period Mexico took more finished articles than during either of the two full previous years.

**Table 3**  
*Casein compounds, galalith, etc., imported into the United States for consumption*

Item	1925		1926		1927	
	Quantity Pounds	Value	Quantity Pounds	Value	Quantity Pounds	Value
In blocks, sheets, rods, tubes, or other forms .....	83,789	\$40,044	94,649	\$19,022	24,586	\$11,740
In finished or partly finished articles .....	56,421	142,317	80,500	186,147	74,799	196,510



### American Casein Plastics Production Limited

Another class of plastic materials now receiving considerable attention is manufactured from casein, the principal protein substance found in milk. Upon treatment with formaldehyde, a tough material, white and hornlike in appearance, is formed. It is noninflammable and capable of taking a high polish. Dyes may be incorporated with it or pigments or fillers used to produce a mottled effect. The resulting appearance rivals that of ivory, coral, tortoise shell, and similar natural products. It is at present used for buttons, beads, fountain pens, and in numerous other ways.

The production of this material constitutes a well-established industry in Europe, where the product is sold under the name of "galalith." Production

of this material in the United States, on the other hand, is limited, and the domestic casein plastic industry is still in its infancy. Imports account for a large part of the American consumption and in 1927 amounted to a little over \$200,000 in value. Present imports are decidedly less than in 1923, nevertheless they show a tendency to increase—particularly of finished or partly finished articles. See Table 3.

### Synthetic Resins Industry an American Development

The invention and application of the class of products known as synthetic resins constitute an outstanding American achievement. They were first made through the condensation of phenol with formaldehyde in the presence of ammonia or hexamethylenetetramine, but in late years the cumaron and indene resins, the so-called sul-

phur resins, the area-formaldehyde, the furfural-formaldehyde and other aldehyde resins, as well as those made from glycerine and phthalic anhydride, have come into wide application. Synthetic resins have a variety of uses, being largely consumed in the manufacture of insulating materials for use in radio apparatus, automobile parts, and as a substitute for amber and other fossil resins in the manufacture of pipes, cigarette holders, and similar articles. Large quantities are employed in the preparation of varnishes and lacquers. The cumaron resins are said to be particularly adapted because of their solubility in organic solvents for the manufacture of varnishes, paints, lacquers, and other products. They are also employed in rubber mixtures as substitutes for rubber and they have been used in the production of linoleum and oilcloth.

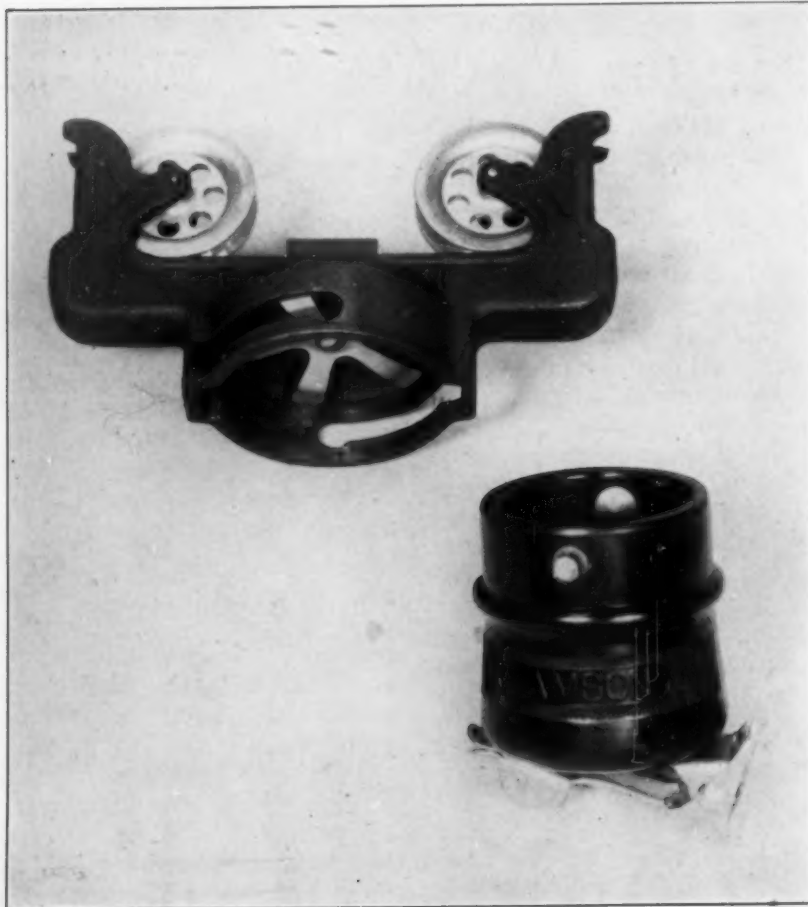
During 1926 the world production of synthetic resins is estimated to have been 13,000 tons, as compared with 900 tons in 1921, and distributed as follows: United States, 40 per cent; Germany, 24 per cent; England, 16 per cent; France, 8 per cent; and other countries, 12 per cent. The 1927 output of synthetic resins in the United States amounted to over 13,000,000 pounds, more than double the quantity produced in 1922.

### Foreign Competition in Plastics

The principal foreign competitors of the United States in the production and distribution of plastics are Japan, Germany, France, and Great Britain. A résumé of the situation in these countries follows:

*Japan.*—It is not surprising, states Assistant Trade Commissioner B. F. Spencer, Tokyo, to find that for years, Japan, the home of the camphor industry, has had a large production of pyroxylin plastics. Aided by cheap labor, a promising industry has been founded in this island empire. Although mainly comprised of the manufacture of numerous small articles, it has grown coincident with other industrial activities of the country until it now has a rank of considerable prominence as compared with the same industry in other countries of the world.

## Molded Cash Carrier



The new Lamson cash carrier molded of Bakelite is a remarkable combination of neat finish and durability.



*Germany.*—Trade Commissioner William T. Daugherty, Berlin, estimates the value of plastic materials produced in Germany in 1926, both compounds and finished articles, at approximately \$75,000,000 and Germany's exports of plastics as at least fifteen times as large as imports. In 1926 exports of plastic articles totaled around 40,000 metric tons, valued at approximately 175,000,000 gold marks, while imports amounted to 1,500 metric tons, with a value of about 12,000,000 gold marks. German exports reach 40 world markets, the chief ones being Great Britain, the United States, the Netherlands, Scandinavia, Switzerland, and Italy.

*France.*—The pyroxylin branch of the French plastics industry has a heavy surplus capacity—about five times the current output, according to Assistant Commercial Attaché Daniel J. Reagan, Paris. Cellulose acetate is gaining in favor, particularly for films, and production and exports are on the increase, as are also the receipts and shipments of synthetic resins and casein plastics.

*Great Britain.*—By far the principal class of plastics in Great Britain is the pyroxylin and of second importance is the casein plastic, reports Assistant Trade Commissioner C. Grant Isaacs, London. Some synthetic resins are used but quantities are relatively small. Great Britain's export trade in pyroxylin and similar plastics is considerably larger than the volume of imports.

#### Principal Foreign Markets of the United States

As previously noted, the English-speaking countries appear to be the best customers of the United States, Canada having taken nearly half of our total exports of these materials. The outlook for increased sales of American plastics in the Dominion, moreover, is favorable. American producers of plastics should continue to sell direct to the large buyers, owing to the limited number and the keen competition.

A brief summary of competitive factors in the principal foreign markets follows:

*Italy.*—Although a domestic industry has been created in Italy and is rapidly asserting itself, there is undoubtedly a growing market in that country for plastics. Competition, indeed, is keen, but the American product, nevertheless, is well known and appreciated.

*Turkey.*—The Turkish market, while competitive, should present a good opportunity for the introduction of American products of this character, since, so far as is known, plastics never have been imported into that country from the United States. Although the Turkish market is primarily a price rather than a quality one, it is believed that in the

(Please turn to page 527)



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## Domestic and Foreign Trade in Plastics

(Continued from page 525)

event of a satisfactory material local importers and consumers might be prepared to pay a certain price difference as compared to German quotations.

**Poland.**—American plastics are practically unknown in Poland and their introduction would involve considerable work in the face of strong French, Austrian, and German competition. Lately, however, there has been a distinct tendency to break away from firms of German domination and dealers are evincing a lively interest in American plastics.

**Spain.**—Spain is a highly competitive but not a quality market and the American manufacturer should be prepared to compete by granting customers facilities similar to those offered by his competitors.

**Rumania.**—This same problem—of price and credit—is the outstanding one to be considered by American houses desiring to enter the Rumanian market for the sale of plastics. Imports of plastic material have increased since 1923, and at present come largely from Hungary and Germany.

**Austria.**—There appears to be some possibility of developing the sale of American pyroxylin plastics in Austria, since, at the present time, all that is consumed in Austria is imported from Germany.

**Belgium.**—Belgium presents an excellent opportunity for the sale of plastics, this market being very receptive to American goods in general.

**Czechoslovakia.**—It is believed that the Czechoslovak market is susceptible of considerable development for American plastics, particularly for firms which are carrying stocks in European bonded warehouses.

**Norway and Denmark.**—Norway is practically a virgin field so far as the production and consumption of all forms of plastics are concerned and this statement also may be made in regard to Denmark. In both countries the trade is at present negligible.

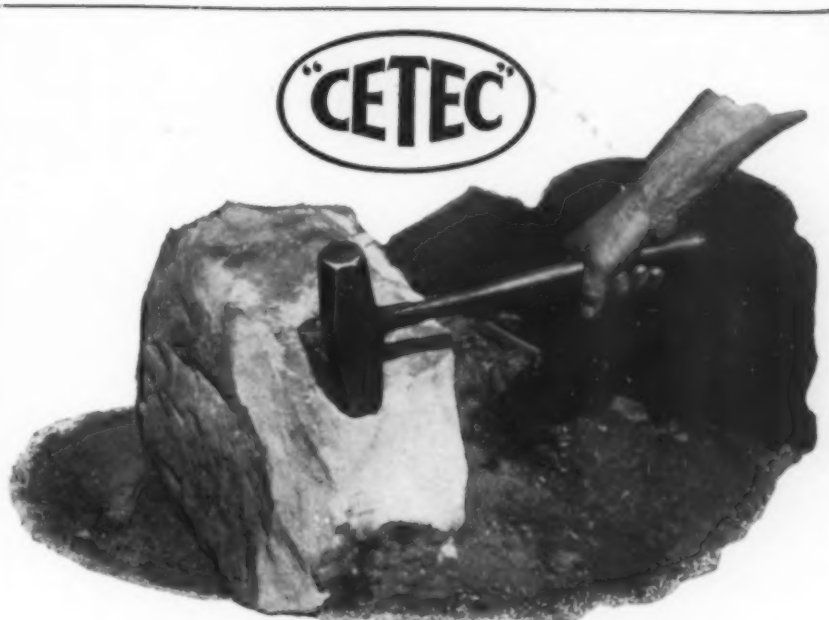
**Sweden.**—In Sweden the demand for plastic materials has increased. Germany and Great Britain furnish the greater portion of the imports.

**Finland.**—American trade with Finland is small, and competition is keen with Great Britain, Germany, and France. American firms, nevertheless, should be able to increase their trade in Finland in both raw products and manufactured goods.

**Mexico.**—Mexico presents a good market for American plastics, practically 95 per cent of the imports of these materials being shipped from the United States.

**Argentina.**—While Argentina produces enormous quantities of casein and sells to the United States over half of the total production, it has steadily declined since 1922 as a market for American plastics. It is be-

(Please turn to page 532)



## It's hard as a Rock

CETEC molded parts are hard as rock. They have high tensile strength and high transverse strength. They are actually fireproof and have dielectric resistance to meet almost any need.

Therefore CETEC parts practically never crack, chip or break. Service costs are less when you use CETEC.

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CETEC color is more than skin deep. It goes clear through the molded substance. CETEC color won't wear off, burn off, peel, stain or tarnish.

In many products color is a big selling appeal today. CETEC can help you with a better kind of color.

We are pioneers in the molding art. Send us models or blue prints of parts you have under development. Send us samples of any parts which are giving you trouble. It is more than likely that our engineers can help you save money—and make your product better.

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# Plastics and the Talking Movies

The part plastic products have played in the development of talking movies

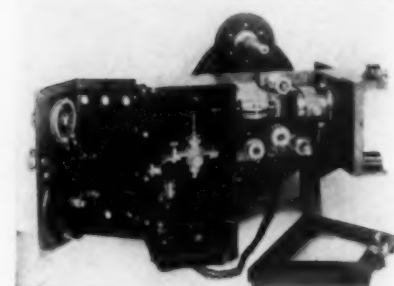
By Carl Marx

**T**HE great development in entertainment made possible by the perfection of the talking moving picture owes a great debt to plastic materials. In every phase of the production of the animated pictures and of the sound that accompanies them, plastic molded articles are used; in fact it would be safe

to say that but for the invention of modern plastic materials and the improvements in molding technique our present-day Vitaphone and Movietone would be impossible.

But where is the connection? the reader may well ask.

First, there is the indispensable film. This consists either of



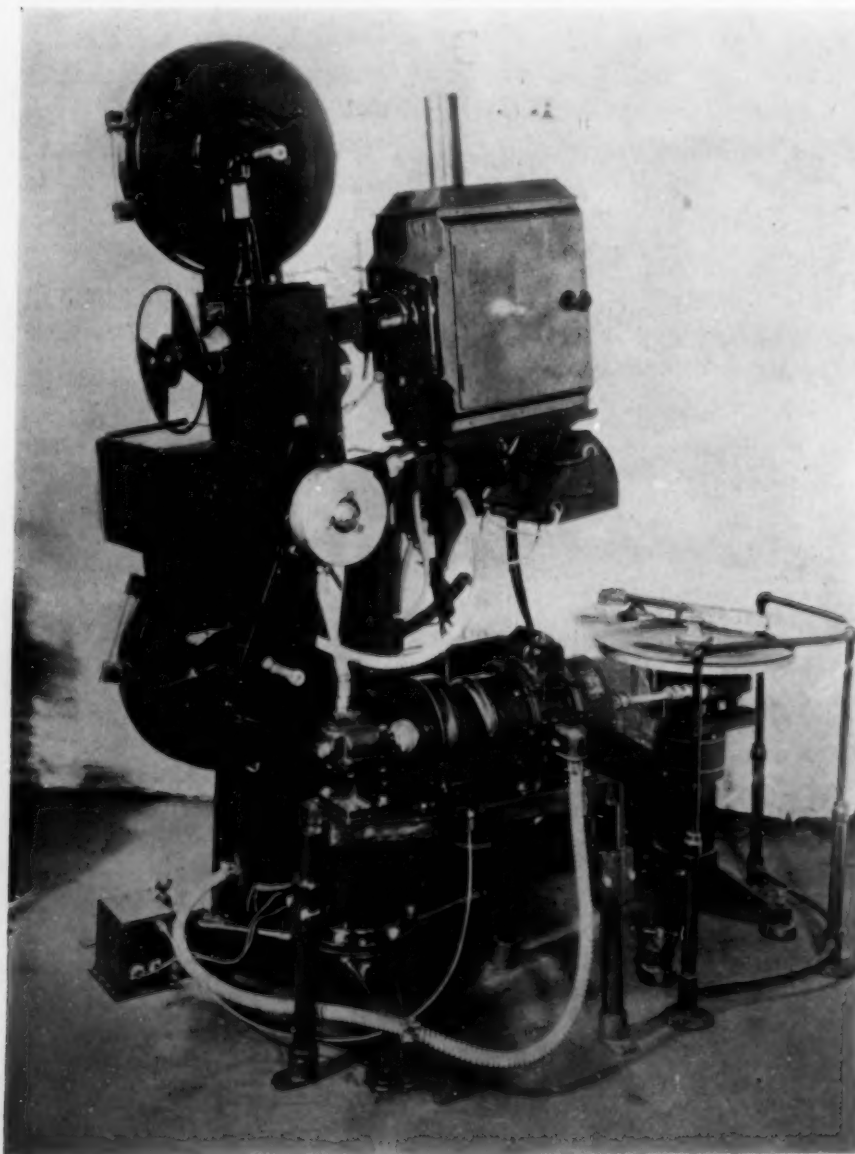
Photoelectric camera through which film passes and by means of which the impressions on the film produce audio frequency vibrations.

cellulose nitrate (pyroxylin), made plastic and supple by the addition of camphor or the more up-to-date plasticizing agents. It may also be made of cellulose acetate, or of ethyl cellulose, if inflammability is to be reduced. Every one of the millions of miles of moving picture film unreel before the projector every day is made of one of these cellulose esters. Development has now reached the stage where even the light-sensitive surface can be made from a cellulose ester or compound, although in one sense this is a return to the collodion film of fifty years ago, though in a vastly improved form.

Without doubt the invention of Celluloid by Hyatt in 1869 laid the foundation for the development of popular photography, both still and moving.

Now as to the sound features. In one form of talking pictures, the sound waves are light-impressed upon the same film with the pictures, the reproduction being accomplished by the modulation of what are essentially telephone currents in an electrical circuit, followed by audio-frequency amplification, the latter being exactly analogous to the public address system or the home radio loud-speaker. Absolute synchronism between the action and the sound is effected by making the sound impression at the same time the action is photographed.

In the other system, the sound is recorded phonographically; that is to say a regular phonograph record is made while the action is being photographed. However, it has been found possible to make the record at a different time, and then



Motion picture projector provided with photoelectric and phonographic sound reproducers. Notice phonograph record on right.

to synchronize the film and the record. The record is, of course, a molded shellac composition, differing in no wise from the regular time-honored disc record. The necessary volume is secured, as in the case of the light recorded film, by amplifying the sound by electrical reproduction as in the Electrola or Panatrope. In fact, the huge loud-speakers used for entertaining the people at outdoor parks by means of the Graybar electrical reproducing units, is simply the Vitaphone minus the picture feature.

The tremendous increase in the requirements for records for the "talkies" thus keeps thou-



Talking movie loud-speaker.

sands of hydraulic presses, and operators, busy in molding the same.

There are, moreover, hundreds of molded parts on the reproducers, transformers, radio amplifying tubes, loud-speakers and switches used in manipulating the talking picture devices. As already mentioned in our pages on several occasions, the up-to-date moving picture camera now has a molded housing in place of the metal ones, so that even in the initial stages molded products enter into the equipment for this new and important amusement and educational art.

Just as plastics have contributed to the perfection of this modern miracle, the speaking pictures, so they will play an equally important part in the

View of Bell Laboratories where the talking movie was developed.



development of other arts; and everyone that is now producing some object of metal, by slow and tedious machining operations, welding and other joining means, had better be keenly on

the alert for the possibility of molding his product, thereby decreasing costs, speeding up production and producing a rustless, permanent and perfect commodity.

## New British Duty Stimulates Demand for Casein Buttons

**D**EMAND on British button manufacturers has increased to such a great extent since the recent imposition of the Safeguarding of Industries Duty on all imported buttons that, instead of about a week, they are now forced to ask between one and two months for delivery of casein buttons. It has been alleged in certain sections of the trade that the duty has practically ruined many Viennese button manufacturers, but the true position appears to be that competition from Japan and France has driven manufacturers in Vienna out of business.

An interesting development in the United Kingdom has been the formation of a new Association of Button and Trimming Importers. Although only organized quite recently, the association already has a good membership. Complaints of under cost selling by Continental firms are being investigated and action is being taken regarding the Safeguarding tax on imported button samples.

This tax was imposed as a result of the appointment on September 30, 1927, by the Board of Trade of a committee

to inquire into an application for a 33½ per cent ad valorem duty on imported buttons, which it had received from the British Button Manufacturer's Association. The applicants contended that British button manufacturing was in a moribund state due to unfair competition, proving their claim by showing the disparity between the number of persons they were able to employ in 1913—6,884—and the number employed in 1926—3,629. A large percentage of the latter figure is employed in making casein buttons, which are enjoying an extensive vogue in the ladies' garment trade. For successful production it was thought that casein buttons were dependent upon originality of design and attractiveness of finish—factors largely independent of price, and which call for an enterprise in anticipating fashion's whims, which are beyond legislative control. The great increase in demand for them since the imposition of the import duty, however, has more or less disposed of this theory and shown them to be as dependent on the price factor as any other type of button. The but-

(Please turn to page 532)

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ALDUR is a permanent colorless and transparent glass-like material.

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ALDUR does not burn but chars at about 250°C.

ALDUR is tough and strong.

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For information write to Box 500, Plastics.

## Domestic Exports of Pyroxylin Products, From the United States, by Countries.

**June, 1928**

Countries	Sheets, rods or tubes		Manufactures	
	Pounds	Dollars	Pounds	Dollars
Austria	.....	.....	338	277
France	.....	.....	6	12
Germany	1,088	1,409	3	38
Italy	8,630	9,987	.....	.....
Spain	.....	.....	176	201
Switzerland	.....	.....	28	108
United Kingdom	85,585	90,765	18,018	7,965
Canada	209,859	122,465	28,309	34,769
Costa Rica	.....	.....	6	28
Guatemala	.....	.....	67	311
Honduras	.....	.....	19	33
Nicaragua	.....	.....	39	228
Panama	.....	.....	49	115
Salvador	.....	.....	28	75
Mexico	339	373	4,719	9,421
Cuba	1,165	1,167	757	1,777
Dom. Republic	.....	.....	498	770
Netherland W. Indies	.....	.....	127	260
Argentina	72	195	372	1,346
Brazil	1,063	1,180	65	99
Chile	.....	.....	243	659
Colombia	.....	.....	60	121
Peru	28	36	34	70
Venezuela	44	52	55	248
B. Malaya	.....	.....	165	1,131
China	.....	.....	110	141
Java & Madura	232	222	.....	.....
Iraq	79	122	.....	.....
Japan	.....	.....	142	300
Philippine Islands	.....	.....	202	331
Australia	11,470	7,939	6,711	9,097
N. Zealand	167	276	173	569
B. E. Africa	.....	.....	14	73
Union of So. Africa	59	52	193	639
Total	310,880	236,380	56,726	71,212
Shipments from				
U. S. to:				
Hawaii	53	58	1,428	2,723
Porto Rico	.....	.....	1,464	1,105

## A Patent of Interest to Molders

CIGARETTE HOLDER. Chas. Morton Bellak, New York, N. Y. Filed June 2, 1927. Serial No. 195,887. 4 Claims. (Cl. 131-10.) Pat. No. 1,684,005.

1. A cigarette holder having a cigarette receiving slotted shell arranged within the cigarette receiving end of the holder formed separately from said cigarette holder and fitted with an ejector device comprising a portion extending to the outside of the holder through the front face of the tip of the cigarette holder and formed to support the holder when laid upon a surface such as a table, the body of said ejector device being positioned between said slotted shell and the inner surface of the forward end of the cigarette holder, and a cigarette engaging portion of said ejector arranged to project through the slot in the shell into the cigarette receiving bore of the slotted shell.

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### New Swedish Packing Combines Cellulose and Pulp

A NEW combination of cellulose and mechanical pulp for packing has recently been launched by the Svenska Emballage Aktiebolaget at Katrineholm, Sweden. This combination is cemented by a special substance, the composition of which is not divulged, and then pressed together and molded in high temperature into special molds. The new substance can be given any shape or size without any joints, and possesses the important characteristics of great toughness and resistance. Owing to the high temperature during the molding process — sometimes amounting to 400 degrees C.—the packing is absolutely free from bacteriae, and can be impregnated so as to resist moisture and acids. This new product may be used for packing all kinds of goods—liquids, soaps, dyes, pharmaceutical products, foodstuffs, electric batteries, radio apparatus, etc.

### New Process for Esterification and Hardening Resin

IN a recent issue of the *Farben-Zeitung*, E. Pyhala describes a process, which he claims to be new, for the esterification and hardening of resin. The process is carried out as follows:—The resin is melted and a finely-powdered calcium compound of an alcohol or a phenol is added gradually and stirred into the mass. After some slight effervescence, reaction ceases, and the lime separates out underneath the mass of esterified resin. Esters prepared in this way give quick-drying varnishes with tung oil, and can be used to prepare varnish resistant to alcohol, benzine and turpentine. The method can be used for the esterification of fatty acids.

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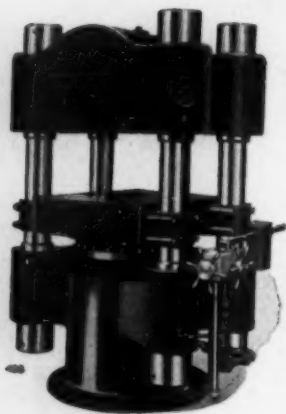
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### "Molded Products on the Table"

In next issue of

**Plastics and Molded  
Products**

### Casein Buttons

(Continued from page 529)

ton duty has only been in force for three months, but every manufacturer now has a feeling that he can get a fair share of the trade, and a large amount of money has already been spent on new plant, which means more workers and larger output. At the factory of H. Walmsley, a prominent member of the Button Manufacturers' Association, production was being carried on with 60 per cent staff prior to the duty, but since then more workers have been taken on, the factory's machines have been filled, and the present problem awaiting solution is how to get in more machines and so take on more workers.

### Domestic & Foreign Trade in Plastics

(Continued from page 527)

lieved, however, that interest could be developed among the local manufacturers of electric insulating materials, radio apparatus, automobile parts and ornaments, if they were acquainted with the advantages of American products.

*Brazil, Chile, Colombia, and Uruguay.*—The requirements of Brazil, Chile, Colombia, and Uruguay for plastics are small. These countries, however, present potential markets for these products, and, with the increase of a number of industries requiring such materials for their operation, there should be manifested a decided improvement.

*China and Egypt.*—In China, quality is not demanded, and since this is a price market, Japan and Germany control practically the entire sales of plastics. The same situation exists in the Egyptian market.

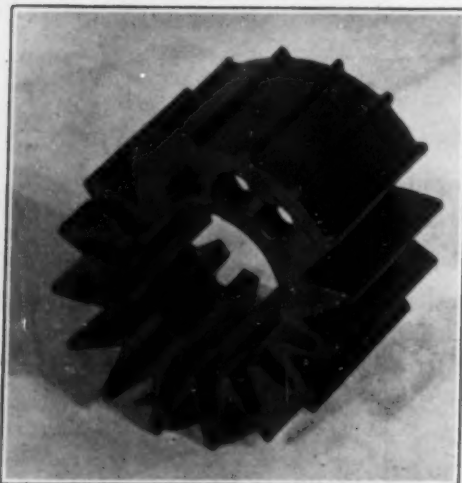
*South Africa.*—Trade with South Africa, while limited because of the small population of the country, could be greatly expanded, particularly in connection with the manufacture of heels for the boot and shoe industry.

*Australia.*—In Australia likewise celluloid is employed to cover the heels of patent-leather and light shoes—comprising an important in-

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dustry and suggesting opportunities for sales of the American product. There is also a good and growing market for American pyroxylin sheeting and for the casein plastics.

In conclusion, it may be said that the production of plastics has exhibited a remarkable growth since the inception of the industry. Despite the present apparent lull in American exports of these materials, furthermore, the inherent worth and utility of plastics products should result in a still larger growth and a continual extension of our markets both at home and abroad.

### Foot-Corrective Appliance

(Continued from page 520)

mal ankle grace, may be avoided.

Trimfoot is as smart and modern as its name implies. And Pyralin, with its combination of strength and thinness and its resistance to deterioration from perspiration, is an important feature in this appliance.

(Du Pont Magazine)

### Pyroxylin Flowers

(Continued from page 517)

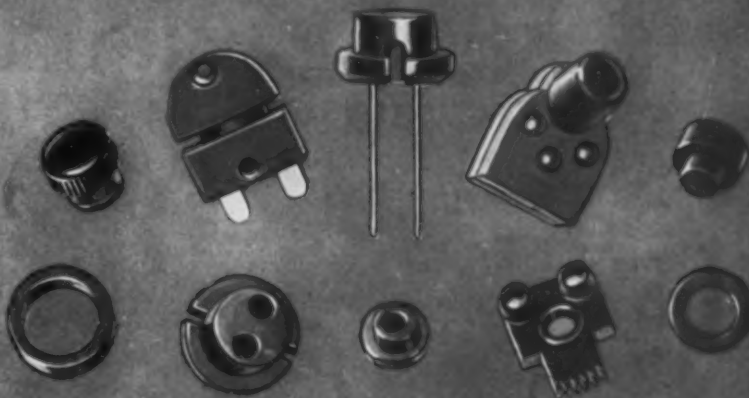
without the aid of color, to show how closely they resemble fresh flowers.

In addition to the long-stemmed ones for decorative purposes, leading fashion authorities advocate short-stemmed flowers as appropriate ornamentations for the shoulder. Transparent Cellophane, which most of us think of as a wrapping material, is also especially suitable for making these buds.

Another favorite use for the flowers is in decorating store windows and counters of fashionable shops. They add a note of smartness to the displays and can be used many times. To retain their attractiveness, they need be dusted only occasionally.

(Du Pont Magazine)

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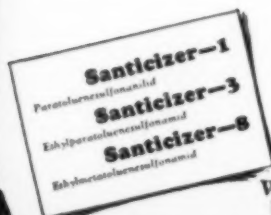
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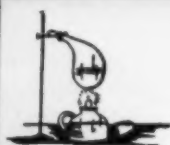
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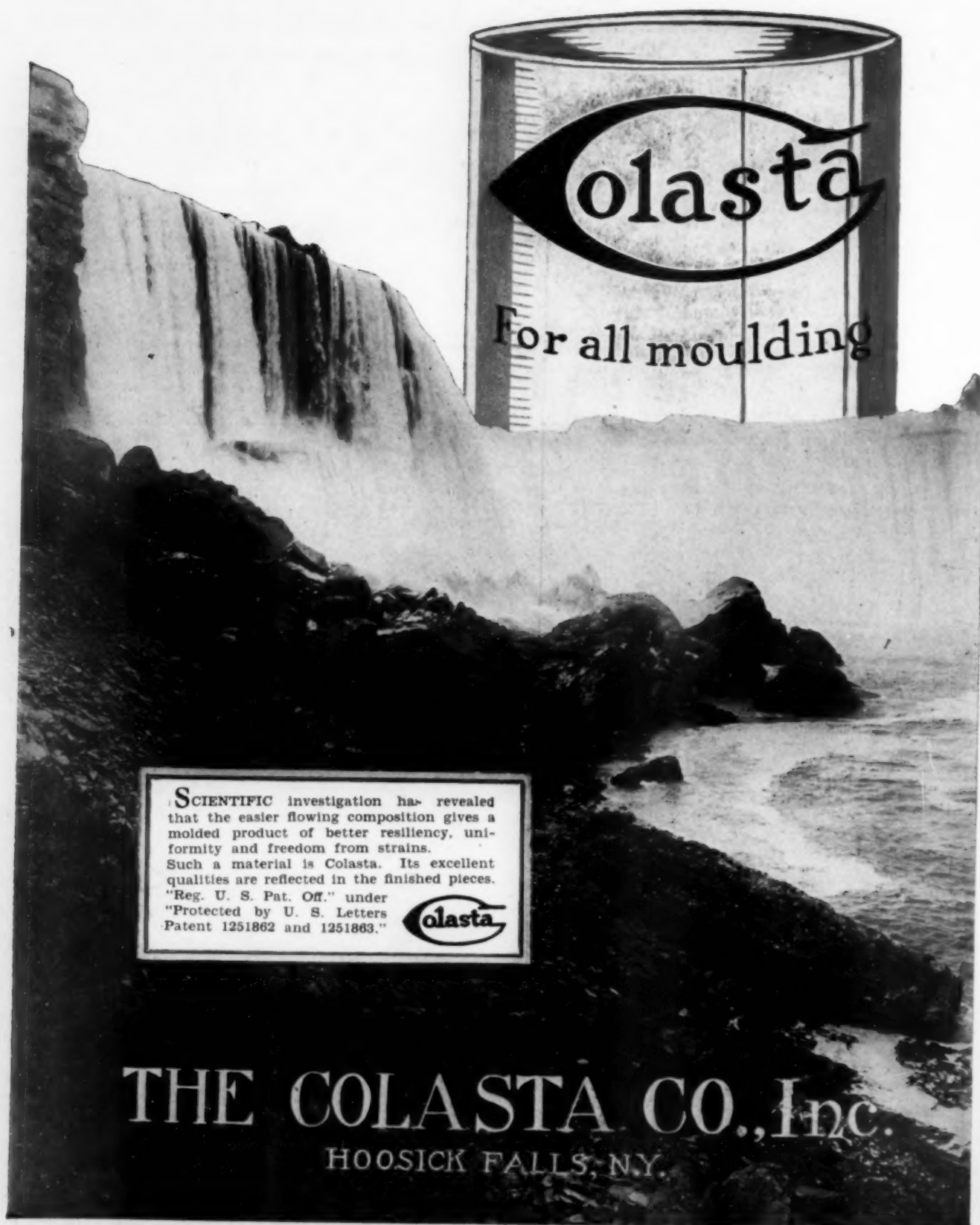
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When writing any of the above please mention *Plastics*

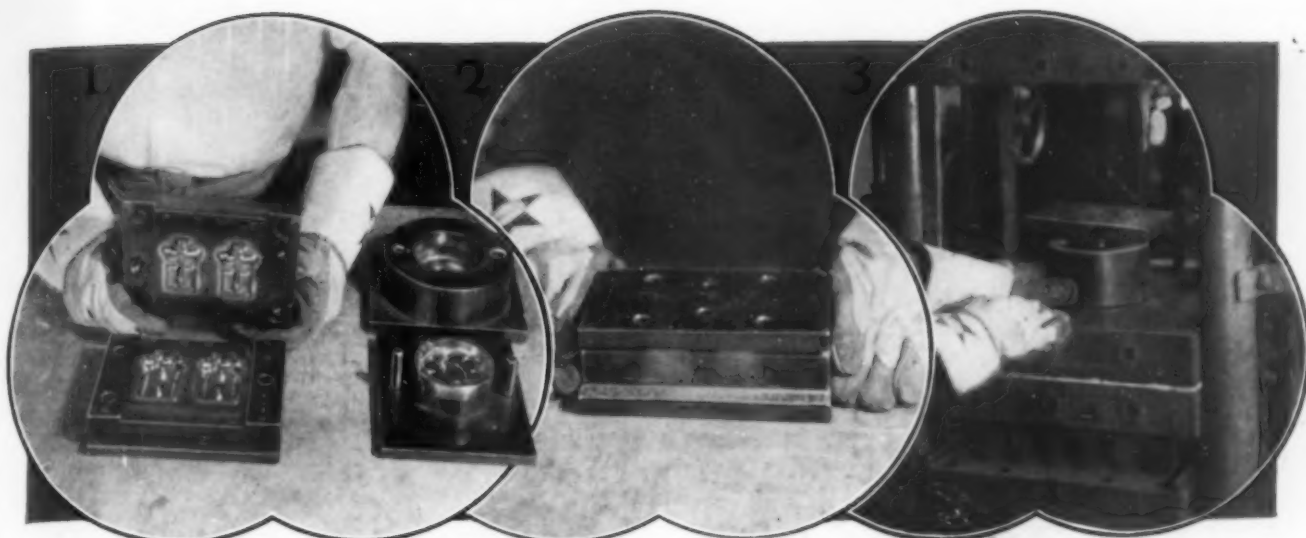


**Colasta**  
For all moulding

SCIENTIFIC investigation has revealed that the easier flowing composition gives a molded product of better resiliency, uniformity and freedom from strains. Such a material is Colasta. Its excellent qualities are reflected in the finished pieces. "Reg. U. S. Pat. Off." under "Protected by U. S. Letters Patent 1251862 and 1251863."

**THE COLASTA CO., Inc.**  
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1. This photograph shows how impossible it is to assemble a mold incorrectly, when it has two dowel pins on one end, and only one on the other. The round mold at the side is also safe-guarded against incorrect assembly, through the use of dowel pins of different diameters.

2. When a force is dropped into a mold, or pushed into place too rapidly some of the powder is almost sure to be blown out.  
3. The top force should be accurately positioned in the mold before it is placed in the press. Otherwise it is likely to be cocked and to cause damage.

## How to assure the correct assembly of hand molds

**H**UNDREDS of molds are needlessly damaged annually through careless or incorrect assembly. The money loss runs into thousands of dollars. It is a loss that may be entirely avoided by strictly adhering to a few simple rules of mold design and assembly.\*

Molds should be made with dowel pins of different diameters, or with pins so located that incorrect assembly is impossible. Another but not so certain a method, is to grind parallel lines or crosses on the end of the chase and the top plate or force, so they will coincide when the mold is correctly assembled.

When working with powder care should be taken to lower the force into the mold gently.

ly. Dropping the force into place will frequently blow out some of the powder, and may result in an imperfect part due to insufficient charge.

When using molds that are not equipped with dowel pins it is well to make sure that the top force has entered the mold cavity before putting the mold into the press. Otherwise the force is likely to be cocked which may cause scoring of the mold surfaces.

By constantly observing these few simple rules, losses through damaged molds will rarely occur, and more uniformly perfect Bakelite Molded parts will be produced. Write for Booklet No. 51 "Bakelite Molded"

\*This advertisement is one of a series in which we are featuring a few fundamental rules of plastic molding. Although obvious to many, we find they are frequently overlooked resulting in a loss of both time and money to the molder. By calling attention to some of these simple rudiments Bakelite Corporation hopes to give its customers the benefit of its long experience in its endeavor to advance the art of plastic molding.

These advertisements have been designed so that they can be placed on the bulletin boards in your Molding Rooms. Extra copies may be had upon request.

### BAKELITE CORPORATION

247 Park Avenue, New York, N. Y. Chicago Office: 635 West 22nd Street  
BAKELITE CORPORATION OF CANADA, LTD., 163 Dufferin St., Toronto, Ontario.

# BAKELITE

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## THE MATERIAL OF A THOUSAND USES

\*The registered Trade Mark and Symbol shown above may be used only on products made from materials manufactured by Bakelite Corporation. Under the capital "B" is the numerical sign for infinity, or unlimited quantity. It symbolizes the infinite number of present and future uses of Bakelite Corporation's products.





## "AMERITH"

The superior quality of "AMERITH" makes it the ideal material for the fabrication of innumerable articles. Your problems can easily be solved with the aid of our trained technical staff backed by fifty years of experience.

A few of the items made of "AMERITH" are: Advertising Novelties, Automobile Curtains, Brushes, Buttons, Cutlery, Guide Card, Laminated Glass, Hair Ornaments, Jewelry, Optical Frames, Toiletware, Umbrella Handles, Wood Heels and numerous other articles.

"AMERITH" in sheets, rods and tubes is truly "The Master Plastic."

## "PROTECTOID"

A new plastic material made in clear transparent, opaque and mottled colors for use where a slow burning material is required.

The introduction of this material has stimulated the Lamp Shade Industry.

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